West Virginia Smart Grid Implementation Plan (WV SGIP) Project

APERC Report on Assessment of As-Is Grid by Non-Utility Stakeholders

Introduction

One goal of this grid modernization project is to assess the current status of the electric power grid in West Virginia in order to define the potential to implement smart grid technologies. Thus, an initial task of this project was to define the current state or 'As-Is' grid in West Virginia. Financial and time constraints prohibited the development and execution of formal surveys to solicit input from the various stakeholders. However attempts were made to obtain their input through informal questionnaires and meeting with focus groups. list of stakeholders which participated in these evaluators and the evaluators of their feedback are are provided in Table 1.

Table 1. List of Stakeholders for Electric Power Grid and Project Evaluators.

Stakeholder	Evaluator
* Electric Power Utility Companies: *American Electric Power, Allegheny Energy, …*	Project Team
* **Government Organizations**: *Legislative, Regulatory, …*	APERC
* **Industrial Companies:** *Metals, Chemicals, …*	APERC
* **Commercial Companies:** *Universities, Businesses, …*	APERC
* **Residential Customers:** *Residential, Renters, …*	APERC

Assessments

APERC pursued various methods of obtaining input about the status of As-Is grid in West Virginia. These endeavors included mailings to select group of government officials and Commercial and Industrial consumers a crossed the state , emailings to a crossection of local consumers from the various sectors and personal meetings with a select group of residential consumers, government organizations, industrial and commercial companies and neighborhood councils.

A select list of persons derived from attendees of the IOF-WV Energy Efficiency Seminar heldin Charleston, WV in November 2008 were sent by US Mail with a prepaid postage return envelope and a cover letter from APERC along with a copy of a questionnaire that was developed by the Project Team. This questionnaire, based on the seven principal characteristics (PCs) of a smart grid, consisted of a ranking a 'maturity matrix' designed to ascertain perception the current state of the electric power grid in WV. The names of technical acronyms in questionnaire were added for clearity. See Attachment 1. The questionnaire was sent to two state senators, two members of the state public service commission, 15 industrial persons from

the aerospace, chemicals, glass and metals industries, three small businesses, and twelve persons from neighbors and academic associates.

About one-third of the persons in this group returned the questionnaire. The state legislators indicated that they were hesitant to complete the questionnaire or did not respond. Two persons from industry responded, these two rated the As-Is grid with its higher scores. It is noted that neighbors gave the current electric power grid higher ratings than did academic associates. A tabulation of these results in terms of PC assessments is shown in Table 2.

Table 2. Results of Mailed Questionnaire

Stakeholder	Mailed	Returned		PC1	PC2	PC3	PC4	PC5	PC6	PC7
Government	**4**	**2**		**2.0**	**1.5**	**2.0**	**-**	**1.0**	**-**	**2.0**
Legislative	2	1		-	-	-	-	-	-	-
Regulatory	2	1		2.0	1.5	2.0	-	1.0	-	2.0
Industrial	**15**	**2**		**2.5**	**2.5**	**2.5**	**2.0**	**1.5**	**2.0**	**1.5**
Commercial	**3**	**1**		**1.0**	**2.0**	**2.0**	**3.0**	**1.0**	**1.0**	**1.0**
Residential	**12**	**6**		**1.7**	**2.2**	**2.0**	**2.5**	**2.2**	**2.2**	**2.3**
Neighbors	6	4		1.8	2.3	2.0	2.8	2.5	2.8	3.0
Academic	6	2		1.5	2.0	2.0	2.0	1.5	1.0	1.0
Totals	**34**	**11**		**18.0**	**21.5**	**21.0**	**22.0**	**18.0**	**18.0**	**20.0**
Averages				**1.80**	**2.15**	**2.10**	**2.44**	**1.80**	**2.00**	**2.00**

Persons in the greater Morgantown community with known interest in community affairs were sent an invitation by email to provide their inputs about the current electric power grid. A less technical opinion questionnaire with four basic questions was developed for this endeavor. See Attachment 2. These four questions asked persons to express their views on the following: 1) whether the electric power utilities have shown interests in upgrading their distribution service equipment, etc., 2) whether the state regulatory authority has proposed any policies toward net metering, etc., 3) whether the local power company has offered its residential customers any alternative pricing options, etc., and 4) whether the consumer and environmental groups have encouraged community support for alternative power source, etc. Individuals were provided with seven varied responses to each of the questions, and were asked to mark those responses that expressed their opinion about each question. An eight-page packet of general information about electricity in West Virginia and specific information about plans for future improvement of the electric power grid was prepared and included with these sent emails. See Attachment 3.

This opinion questionnaire with a broad community focus about electric power was emailed to 44 persons throughout the greater Morgantown community. This group included persons from state legislatures, city administration, advisory committees, recreation boards, government laboratories and church officers. A correlation matrix was developed to convert the results from this opinion questionnaire to results for the principal characteristic questionnaire. See Attachment 4.

Only two individuals (about 5%) returned this questionnaire. Their opinions regarding the status of the grid, where correlated to the original principal characteristics questionnaire, and the results are presented in Table 3.

Table 3. Results of E-mail Questionnaire

PC1	PC2	PC3	PC4	PC5	PC6	PC7
1.64	**2.50**	**1.10**	**2.50**	**1.50**	**1.23**	**1.83**

The final endeavor to solicit input on the status of the grid consisted of a presentation to a focus group and a request for feedback following the presentation. Members of the Morgantown Neighborhood Coordinating Council attending the February meeting were provided with a verbal report about the WV SGIP Project, including news from the published articles by Pam Kasey in the State Journal titled "W.Va. to Get First Statewide Smart Grid Plan" and "Wise Wires: Smart Power Distribution Coming During Next Decade". The attendees included many Morgantown community activists whom have strong interests in the affairs of the residential community. The attendees consisted of ten individuals including city administrators, ward representatives and neighborhood leaders.

A further simplified version of the questionnaire was provided to the attendees. A copy of this questionnaire is provided in Attachment 5. After the presentation the attendees were asked to assessed the status of the current residential electric power service in West Virginia.. Their opinions were made with respect to how the electric power company, the State government, the electric power consumer and the informed resident were viewed as contributors to the current electric power grid in West Virginia.

The results of this endeavor to assess the residential opinion about the current electric power grid in West Virginia are provided in Table 4. These results, while informative, were not correlated to yield alternative assessment results comparable to principal characteristic results.

Table 4. Results of Presentation and Questionnaire

Assessment of	Rating
Electric Power Company	2.6
State Government	2.1
Electric Power Customer	2.9
Informed Resident	3.2

Summary

The results of these endeavors briefly described in this report have revealed that most consumers know little about the current status of their electricity grid or the technologies and the potential benefit associated with a smart grid. Therefore a significant educational effort will be necessary in order to ensure consumer support of a smart grid. This became more evident as the questionnaires were continuously simplified and respondents were still uncertain as to the current status of the grid. Although these were not scientifically designed questionnaires and the

results were based on limited responses they reveal the need for an educational component in the implementation plan.

Acknowledgement

Special thanks to Carl Irwin and his staff at the IOF-WV Program for providing valued contacts with industrial persons across the state in a very timely manner.

List of Attachments

Attachment 1: * Cover letter from APERC mailed to 34 Selected Government, Industrial, Commercial and Residential persons, 1 page.

* Copy of **"Principal Characteristics" Opinion Questionnaire** **…**……. p 6 based on Maturity Matrix, with names for the technical acronyms in Questionnaire added for better general understanding, 7 pages.

Attachment 2: * Invitation to Home Owners and Renters to Participate in Grid Assessment; Overview of Project, distributed to 44 persons from state legislatures, city administrations, advisory committees, recreation boards, government laboratories and church officers, and

* Copy of **"Less Technical" Opinion Questionnaire** …… p 13 based on four questions about local power utility, state government, typical electric consumer and general local resident. 2 pages.

Attachment 3: * Document of General Information about Electricity in West Virginia and Plan for Its Future Improvements. Cover page plus 8 pages.

Attachment 4: * Matrix to Correlate "Principal Characteristics" Opinion Questionnaire and "Less Technical" Opinion Questionnaire. 1 page.

Attachment 5: * Copy of **"Further Simplified" Opinion Questionnaire** **……** p 25 based on first impressions from discourse about four aspects of the current electric power situation in State as shared with 10 members of City Neighborhood Coordinating Council to gain their inputs about current electric power service. 2 pages.

Appendix 1: * Copy of **Comment** proposed to The State Journal by APERC for 'posting' about Smart Grid in order to further inform the public about the WV SGIP Project and to possibly receive additional input opinions from interested persons across the State.

Note

Personal contacts and conversations were made with three local delegates to the State Legislature before the start of the legislative session in Charleston on February 11, 2009.

Attachment 1

Date:
To:

From: Ali Feliachi (304) 293-6371
Advanced Power and Electricity Research Center (APERC)
West Virginia University
Morgantown, WV 26506

Re: Grid Modernization in West Virginia

Introduction

Modernization of the electric power grid in our country is becoming the focus of much interest and considerable involvements through federal programs such as the US DoE Modern Grid Strategy (MGS). One project that is underway here in West Virginia is the Smart Grid Implementation Plan (SGIP) project.

A goal of this SGIP project is to assess the current status of and the potential implementation of grid modernization efforts. An initial task of this project is to define the 'As-Is' grid in West Virginia. One of the participants in such an assessment effort certainly needs to be the consumers in West Virginia.

Questionnaire

Attached is a questionnaire that has been developed so that you can provide important input about the status of the As-Is grid and implementation of the smart grid in West Virginia. This assessment of the smart grid status is based on seven principal characteristics identified as PC1 to PC7. For example, the title for PC1 is 'Enable Active Consumer Participation'. Below the title on each of the seven PC sheets are five descriptions of the 'As Is' assessment of the grid in West Virginia. The five descriptions of the 'As Is' status for PC1 about consumer participation in the modernization of the grid in West Virginia vary from 1. Dumb meters, etc to 5. Full deployment, etc.

You are asked to mark the one box on each of the seven PC sheets that best describes your assessment of that principal characteristic of the 'As-Is' grid in West Virginia and then return the seven PC sheets in the postage paid envelope. Please return the questionnaire if possible by , December , 2008. Feel free to contact me should you have any questions or comments.

Thank you.

Principal Characteristic Opinion Questionnaire

with names for technical acronyms added

PC1 Enable Active Consumer Participation

☐	1. •"Dumb" meters , varying amount of AMR (Automated Meter Reading), no AMI (Advanced Metering Infrastructure), traditional rates, monthly bills, little price visibility •minimal consumer involvement, few choices
☐	2. •AMR (Automated Meter Reading), TOU (Time of Use) rates being discussed, considering AMI (Advanced Metering Infrastructure), little or no DR (Demand Response) in place (none using smart meters), consumers questioning value of Smart Grid
☐	3. •AMI (Advanced Metering Infrastructure), pilots in progress, consumers interested in new options, regulatory climate supports advanced rates, utility security concerns are satisfied, limited deployment of home area networks.
☐	4. •AMI (Advanced Metering Infrastructure) deployment completed in specific regions, DR (Demand Response) in place with smart meters, consumers active in deploying smart appliances, PHEV (Plug-in Hybrid Electric Vehicles), DG (Distributed Generation), and home area networks , activity with RTO (Regional Transmission Organization) underway to link to consumer, dynamic real time rate structures in place
☐	5. •Full deployment of integrated Demand Response and AMI (Advanced Metering Infrastructure) system, Ubiquitous access to markets, extensive consumer participation, "E-bay" level of activity •deep integration of consumer status with OMS (Order Management System), AMI (Advanced Metering Infrastructure), becomes a platform for new consumer-side applications in the home.

PC2 Accommodates all generation and storage options

☐	1. •Little or no grid connected distributed resources, interconnection standards are expensive and complex , grid design does not support "plug or play"
☐	2. •Minimal deployment of DG and storage, integration limited due to inability of distribution feeders to accommodate two-way power flow, simplified but safe interconnection standards available.
☐	3. •Wide penetration of DER (Distributed Energy Resources) as distribution circuit conductors, communications and control and protection schemes are upgraded to accommodate two-way power flow, emerging opportunities for integrated DG (Distributed Generators) and energy storage.
☐	4. •New tariffs incent DER (Distributed Energy Resources) deployment, integrated operation of multiple DER devices and microgrids on a single feeder, central DER coordination at substation or higher system level.
☐	5. •Wide deployment of DER (Distributed Energy Resources), PHEV's (Plug-in Hybrid Electric Vehicles) and storage, full plug and play capability, ubiquitous two-way power flow from DER , centrally coordinated for optimal grid operations, virtual power plants are created by aggregating DER that is controlled as a single entity, generation planners consider DER an equal to central generation, DER owners earn revenue by providing ancillary services to RTO (Regional Transmission Organization)

PC3 Enables new products, services and markets

☐	1. •No consumer interaction with utility or RTO (Regional Transmission Organization), limited wholesale markets
☐	2. •Limited Demand Response and energy efficiency programs are in place , Demand Response pilots/experiments are in progress •utility is market participant at RTO (Regional Transmission Organization), energy prices based on time of use.
☐	3. •Combined DR (Demand Response) and AMI (Advanced Metering Infrastructure), technologies emerging to change customer conservation behavior, Home Energy Management systems are deployed in some areas, market tariffs for ancillary services emerge to incent consumer participation.
☐	4. •Access to RTO (Regional Transmission Organization), markets available in specific regions, value of consumer involvement well understood, transactions occur among consumers, utilities, and RTO's in real time, AMI (Advanced Metering Infrastructure) communications infrastructure can support multiple HAN (Home Area Network) applications, DR (Distributed Resources), DER (Distributed Energy Resources) and energy efficiency programs in place, transmission congestion eliminated.
☐	5. •RTO's (Regional Transmission Organization), are nationally integrated, consumers offer their resources to the utility and RTO for reliability and market benefits, widespread deployment of "grid-aware" consumer products in home, consumer involvement has significant impact on grid operations

PC4 Provides PQ for 21st century needs

☐	1. •Reactive response to customer PQ (Power Quality) complaints, adversarial discussions over who is responsible for fix.
☐	2. •PQ (Power Quality) monitoring systems installed proactively, PQ unit created within utility, utility investment planning processes include consideration of PQ.
☐	3. •Minimally acceptable PQ (Power Quality) levels for all customers established, backed up with system designs/investments that deliver this level, companion strategy to provide price differentiated PQ consistent with consumer needs.
☐	4. •PQ (Power Quality) metrics established and performance trends tracked , Advanced technology deployments include: remote PQ Sensing, static var compensation, power electronic PQ devices, spike and harmonic filters, and PQ parks.
☐	5. •PQ (Power Quality) objectives included in management performance evaluations, Identification and resolution of PQ issues are a priority, Levels of PQ established for different prices supported by customers, regulators and utility.

PC5 Optimizes assets and operates efficiently

☐	1. •Limited grid information available to operators, planners, engineers, customer service reps and maintenance personnel, Time-based maintenance is predominant, Traditional energy efficiency programs available to consumers
☐	2. •Asset management program is a priority at utility, increasing interest in condition based maintenance, dynamic ratings of assets, and reducing system losses, limited deployment of sensors for monitoring asset health and condition, Increased focus on more aggressive energy efficiency programs
☐	3. •Asset condition and health sensors being deployed for critical assets system wide, capability exists to process the large amount of new data to information, limited integration with GIS (Geographic Information System) and other enterprise wide processes, DR (Demand Response) employed to improve asset utilization, AMI (Advanced Metering Infrastructure), reduces energy theft and identifies electrical losses, Utility enterprise-wide systems are being integrated using Service-oriented Architecture technologies (SOA).
☐	4. •Regionally deployed health and condition sensors integrated with AMI (Advanced Metering Infrastructure), and GIS (Geographic Information System) to enable at least one of the following processes - system planning, condition based maintenance, outage management, system loss reduction, work management, customer service, engineering, Modeling, simulation and visualization tools enable operators to perform "what if" analyses, Enterprise-wide level visualization system deployed and integrated with AMI, GIS, OMS (Order management System) , DA (Distribution Automation), DR, DER, work management, etc.
☐	5. •High level of granularity of grid intelligence available, operating and asset health data deeply integrated with operating and asset management applications, dramatic improvement in enterprise wide processes - GIS, system planning, maintenance, outage management, work management, customer service, engineering, improved load factors allow existing assets to be fully utilized.

PC6 Anticipates and responds to disturbances

☐	1. •Reactive protection of assets, circuit breaker trips after fault occurrence , limited monitoring (grid sensors and SCADA (Supervisory Control and Data Acquisition)) of equipment status and health to warn of degraded conditions •run to failure strategy.
☐	2. •Increased monitoring, control and visualization technologies deployed (e.g. SCADA, PMUs (Phasor Measurement Units), transformer gas analysis), with research initiated to develop new methods (e.g. EMI Electromagnetic Interference) analysis) of monitoring asset health, digital relays replace electromechanical ones, DA (Distribution Automation) pilots initiated on a small scale
☐	3. •Digital relays networked through a digital communications platform , advanced operator visualization tools and real time data collection (SCADA) installed at system control centers, automation deployed where appropriate across entire distribution level AMI integrated with distribution OMS (Order Management System) •DA deployment strategies developed and deployments are underway
☐	4. •System Integrity Protective Systems (SIPS) ensure regional reliability, adaptive relaying deployed, system-wide controls installed to process extensive system real time data, including WAMs inputs, and take instantaneous actions when manual operator action would be too slow, DER and DR integrated with DA and feeder backup is underway , islanding services available to customers, all critical system assets are monitored in real time (SCADA fully deployed).
☐	5. •Ubiquitous digital communications platform integrates multiple self healing technologies, deep deployment of grid sensors, distributed generation and storage, feeder backup and control devices enable early detection and resolution of degraded conditions, outage and restoration times minimized, disturbances prevented through autonomous control.

PC7 Operates resiliently against attack and natural disaster

☐	1. •Centralized model with stressed and aging assets make the grid vulnerable to attack and natural disaster, Service restoration slow and based on customer call-in
☐	2. •Cyber security is a prime consideration, utility support for decentralized generation and storage (DER) exists, aging assets are replaced with new, more intelligent and robust technologies.
☐	3. •AMI (Advanced Metering Infrastructure) penetration growing, providing tool for more rapid service restoration, some distributed generation, storage technologies, self healing technologies deployed, most assets monitored to detect challenges, increased grid intelligence, advanced visualization technologies that provide increased situational awareness under evaluation
☐	4. •Service restoration faster due to fully deployed AMI (Advanced Metering Infrastructure), regional advanced detection, diagnosis, and autonomous corrective action in place , cyber security standards are well defined and incorporated in new designs, more than half of consumers have back-up power, local micro-grids emerge.
☐	5. •Advanced visualization tools integrated with enterprise-wide technologies to optimize situational awareness and reduce reaction times, System-wide grid intelligence is used to deter, detect, mitigate, and rapidly restore from deleterious impacts, majority of consumers have back-up power , micro-grids deployed in all critical areas.

Attachment 2

Less Technical Opinion Questionnaire

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

Home Owners and Renters Comment on Electric Power Grid

Invitation to Participate in Electric Grid Assessment

Date: January 23, 2009

To: Home Owner or Renter
Customer of Electric Power
Any Neighborhood Street
Morgantown, WV

From: Ali Feliachi Phone: (304) 293-6371 x2529 Fax: (304) 293- 8602
Advanced Power and Electricity Research Center (APERC)
841B ESB CSEE Department West Virginia University
Morgantown, WV 26506-6109

Re: Project Overview and Opinion Questionnaire

Project Overview

Modernization of the electric power grid in our country is becoming the focus of much interest and considerable involvements through federal programs such as the US DoE Modern Grid Strategy (MGS). One project that is underway here in West Virginia is the Smart Grid Implementation Plan (SGIP) project.

A goal of this SGIP project in West Virginia is to assess the current status of electric power grid and the potential to implement grid modernization. One of the participants in such an assessment is the home owner or renter as a consumer of electricity.

Opinion Questionnaire

Below are four questions developed by the Project so that you as a home owner or home renter can provide important input about the status of the current electric power service and the potential for implementation of the smart grid in West Virginia.

Please mark each **O** before those responses of the seven responses provided that best express your opinion about each question; i.e., fill in none to seven of the **O** as your response to each of the four questions.

Question 1. Your Appreciation of Electric Power Company. What technology upgrade equipment and services are currently offered by your electric power company to make your home become part of the grid modernization in West Virginia?

Seven Possible Responses as Your Perspective of the Electric Power Utility.

O UR1. Company outlays for smart grid equipment will not be cost effective.
O UR2. Power quality is a more important necessity for tomorrow's home.
O UR3. Potential outages dominate our home operating expense budget.
O UR4. Electric power companies are slow to discover anything new.
O UR5. Real-time communications by power company with my home will be a challenge.
O UR6. Overload protection and rerouting of electric power already work okay.
O UR7. Overall vision of the electricity market by power company is good.

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

Opinion Questionnaire ... continued.

Question 2. Your Awareness of the WV Regulatory Agency. What incentives do you understand have been incorporated in our state regulatory rate policies to encourage a home owner or renter to pursue incorporating smart grid technologies into the home?

Seven Possible Responses as Your Perspective of the Regulatory Agency.

- **O** AR1. Customer participation in regulating grid modernization is important.
- **O** AR2. New smart grid equipment, if regulated, will become expensive.
- **O** AR3. Regulations are more needed to encourage use of renewable energy sources.
- **O** AR4. The current grid regulation is very challenged and problematic.
- **O** AR5. The load demand profile for my home is very simple.
- **O** AR6. Regulatory policies are more needed for environmental problems.
- **O** AR7. Distributed generation is opposed by the electric power company.

Question 3. Your Observations as an Electricity Customer. What forms of encouragement has the electrical power company provided its customers about smart grid enhancements that could result in more reliable power electric power to your home?

Seven Possible Responses as your Perspective as an Electric Power Customer.

- **O** CR1. Electric power company does not seem to have a clue about smart grid.
- **O** CR2. Grid modernization is well underway in our community.
- **O** CR3. Home owners need more incentives from the electric power company.
- **O** CR4. Technical staff of company may have plans, but probably no funds.
- **O** CR5. Company probably should first simplify its monthly bill.
- **O** CR6. My home has no electric power problems to solve.
- **O** CR7. More customers is a higher priority for power company than a smart grid.

Question 4. Your Concerns as an Informed Resident of WV. What endeavors have there been by energy advocates and user groups in your community to encourage the electric power industry to pursue smart grid technologies?

Seven Possible Responses as Your Perspective as a Member of Society.

- **O** SR1. Natural disasters are an expected part of life for a community.
- **O** SR2. Environmental concerns are largely caused by electric power companies.
- **O** SR3. Power-hungry residential users are the main grid problem.
- **O** SR4. Global climate change issues need more community advocates.
- **O** SR5. Affordable alternative sources of energy are not offered by power company.
- **O** SR6. Economic downturn will reduce the need for smart grid.
- **O** SR7. Consumers will be more participatory if power company shows examples.

Thank you very much for your interest in assessing the current status of the electric power grid in WV in order to determine the potential to implement smart grid technologies. If you have any questions, you can email me at alfeliachi@mail.wvu.edu or call 304 293-6371 x2529.
When you have **completed this Questionnaire**, you can email it to me or send it to me at my address above, fax it to me at (304) 293-8602 or deliver it to my WVU office at 841B ESB.

The Project would welcome receiving your input before Wednesday, January 28, 2009.

Attachment 3

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

General Information

about

Electricity in WV and a Plan for Its Future Improvements

A Smart Grid and the Electric Power Grid in WV, *pp 1-3*

This Project and its Goals of Consumer Awareness and Grid Evaluation, *pp4-8*

January 23, 2009

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

Page 1. Article Published by Reuters on 1-8-09

What is a Smart Grid?

Reported by Bernie Woodall; Edited by David Gregorio

President-elect Barack Obama on Thursday said an economic stimulus package should include building a new electricity "smart grid".

"Smart grid" describes a more efficient, cost-saving method of moving electricity along major long-distance transmission lines to local distribution power lines and disparate end-users in homes, businesses and schools.

The estimated cost of creating a nationwide "smart grid" by investor-owned utilities in the United States is $50 billion over 10 to 20 years, said Ed Legge, an analyst with the Edison Electric Institute, a power industry lobbyist. Adding federally and locally owned utilities, the full cost would be about $65 billion.

Smart grid advocates say utilities and customers will realize cost savings in the long run, despite the high roll-out costs.

In a smart grid, computers and sensors, installed at power plants, substations and along power lines, would signal control centers that would better manage the flow of electricity. For instance, computers would detect transmission bottlenecks and direct power around them.

Power outages are now monitored as customers call local utilities to report them. Smart grid computers would discover outages automatically.

"Smart meters" would be installed to replace conventional electricity meters. These would facilitate communication between utilities and their customers, letting them curb power use when demand peaks and prices are high.

Cutting demand during peak hours would reduce the need for capital spending on more power plants, substations and power lines. Proponents say it also will cut greenhouse gas emissions blamed for global warming.

The meters combined with smart appliances would make it possible to control and regulate appliances remotely.

Proponents say "smart" technology also will help renewable power sources like solar panels and solar power plants and wind farms integrate into the overall transmission system.

Conventional power grids have difficulty with the intermittent nature of solar and wind power.

Smart grid technology is in various forms of planning and implementation depending on the utility or state jurisdiction.

Investor-owned utilities account for about 70 percent of U.S. electricity use. Several utility companies have begun replacing conventional electricity meters with "smart meters" that receive signals from the grid and send signals back to grid operators.

After year-long study of smart grid technologies in the Pacific Northwest, U.S. officials and IBM estimated customers saved 10 percent on monthly power bills and cut power use by 15 percent.

If those figures could be realized nationwide, it could save between $70 billion and $120 billion in spending on new power plants and transmission lines, the study found.

The U.S. Department of Energy's website addresses smart grid technology.

Note: See, for example, the website http://www.oe.energy.gov/interactive grid.htm.

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

Page 2. Public Service Commission of West Virginia (PSC of WV)

Smart Grid Consideration in West Virginia

Approved Order by PSC of WV

CASE NO. 08-2072-E-GI
General Investigation into the Smart Grid Standards set forth
in the Energy Independence and Security Act of 2007.

NOTICE

NOTICE is hereby given that the Commission has initiated a general investigation proceeding to consider the requirements of Title XI11 of the Energy Independence and Security Act of 2007 ("EISA"), Section 1307, State Consideration of Smart Grid.

The Commission will be considering and determining whether to adopt the standards of EISA regarding the "Smart Grid," the modernization of electricity transmission and distribution systems across the United States. All jurisdictional electric utilities in West Virginia have been made parties to this proceeding.

Anyone desiring to intervene must file a written request to intervene on or before January 30, 2009. Failure to timely intervene can affect your rights to protest and to participate in future proceedings. Requests to intervene must comply with the Commission's rules on intervention. Any petitions to intervene, comments or protests should be addressed to the Executive Secretary, Public Service Commission of West Virginia, P.0. Box 812, Charleston, West Virginia 25323.

By a Commission Order entered December 12, 2008, the Commission set this matter for a hearing to be held on September 14-15, 2009, beginning at 9:30 a.m., in the Howard M. Cunningham Memorial Hearing Room, 20 1 Brooks Street, Charleston, WV. The hearing is open to the public.

EXECUTIVE SECRETARY
PUBLIC SERVICE COMMISSION
OF WEST VIRGINIA

Note: The entire Case Document can be viewed at the PSC WV website
http://www.psc.state.wv.us/scripts/WebDocket/ViewDocument.cfm?CaseActivityID=255407.

Your Opportunity to Participate in Electric Power Grid Study

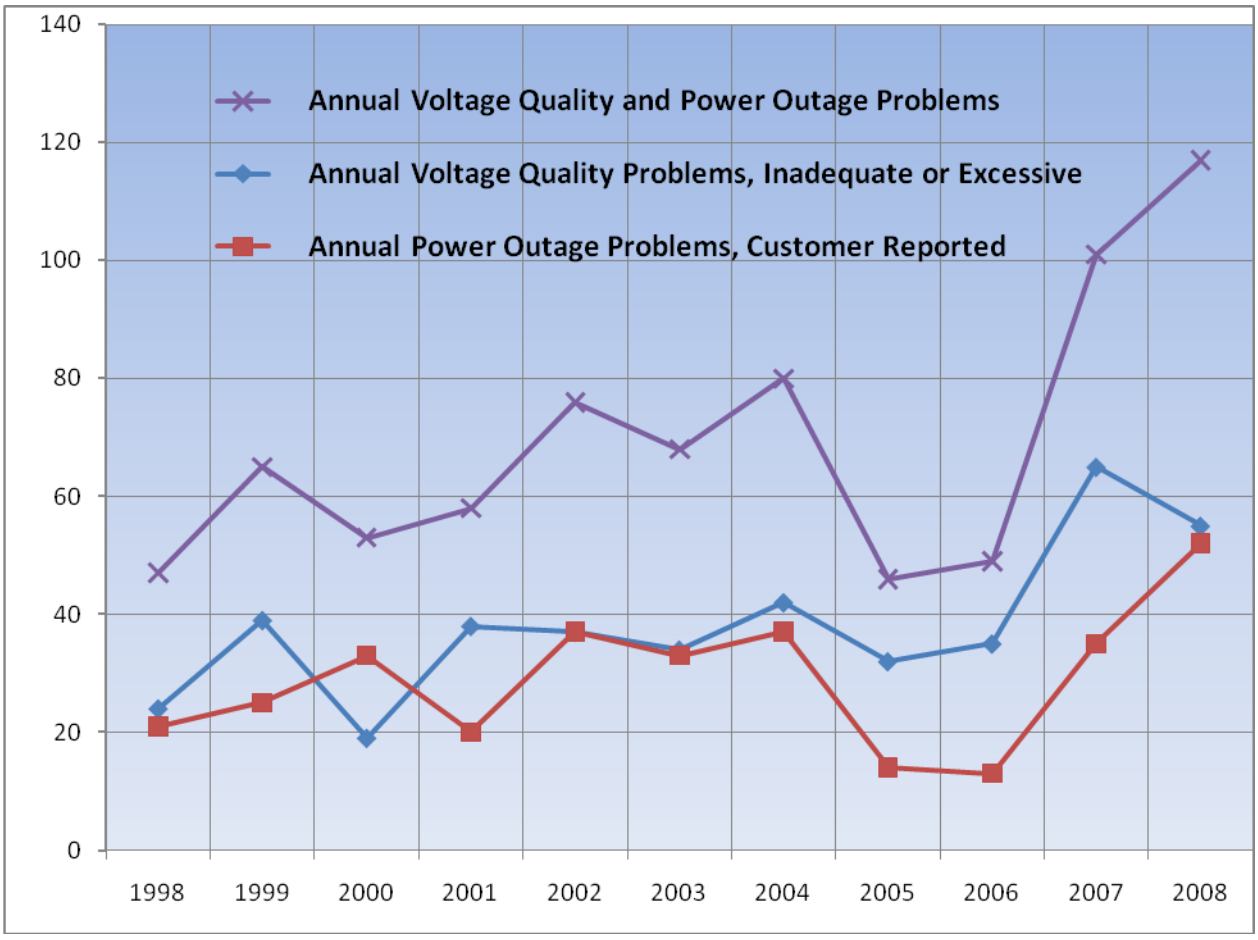
Page 3. Customer Complaints Compiled by PSC of WV

Complaints about Current Electric Power Grid

Graph of Past Quality and Outage Complaints

The graph below shows the number of informal complaints received by the Public Service Commission of West Virginia (PSC of WV) regarding the quality of electric power in West Virginia. These complaints were coded by the PSC Staff.

The average statistics for these complaints are 29.1 reported power outage problems each year (42%) and 38.2 reported voltage quality problems each year (55%). There were 1.8 other reported problems each year (3%).



Note: The data for the above graph was provided by the PSC of WV. Data is also available per utility company (Appalachian Power, Monongahela Power and Potomac Edison).

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

Your Opportunity to Participate in Electric Power Grid Study

Page 4. Project Goals per US DOE Modern Grid Initiative Program

The WV SGIP Project

Project Status per Team Meeting on 12-15-08

Main Agenda Items for Recent WV SGIP Project Team Meeting

Purpose

The main purpose of the meeting is to reach consensus on the Current and Future States of the Grid in West Virginia from the team perspective. Also, updates for the Gap Analysis and Business Case will be given.

Current State of the Grid

The remaining Current State Data Holes: Results of the "racking up" of the Current State data and Getting the last few, high value data elements into the analysis

Future State of the Grid

The Future State includes three parts: individual scoring, MM Tool scoring, and Probable Future States Scenario scoring

Gap Analysis

The Gap Analysis will compare the Business As Usual vs the Accelerated Smart Grid. The dimensions of the Gap will be technology implementation/deployment, regulatory and policy, consumer systems, and electricity market

Business Case

The Framework for the Business Case will be comparing the baseline costs and benefits of a Business As Usual case compared to the calculated cost and benefits of an Accelerated Smart Grid case.

The Team for the WV SGIP Project includes participants from the National Energy Technology Laboratory, Allegheny Power, American Electric Power, Science Applications International Corporation, Augusta Systems, Horizon Energy Group, Renz Consulting, West Virginia Division of Energy, National Research Center for Coal and Energy and the WVU Advanced Power and Electricity Research Center.

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

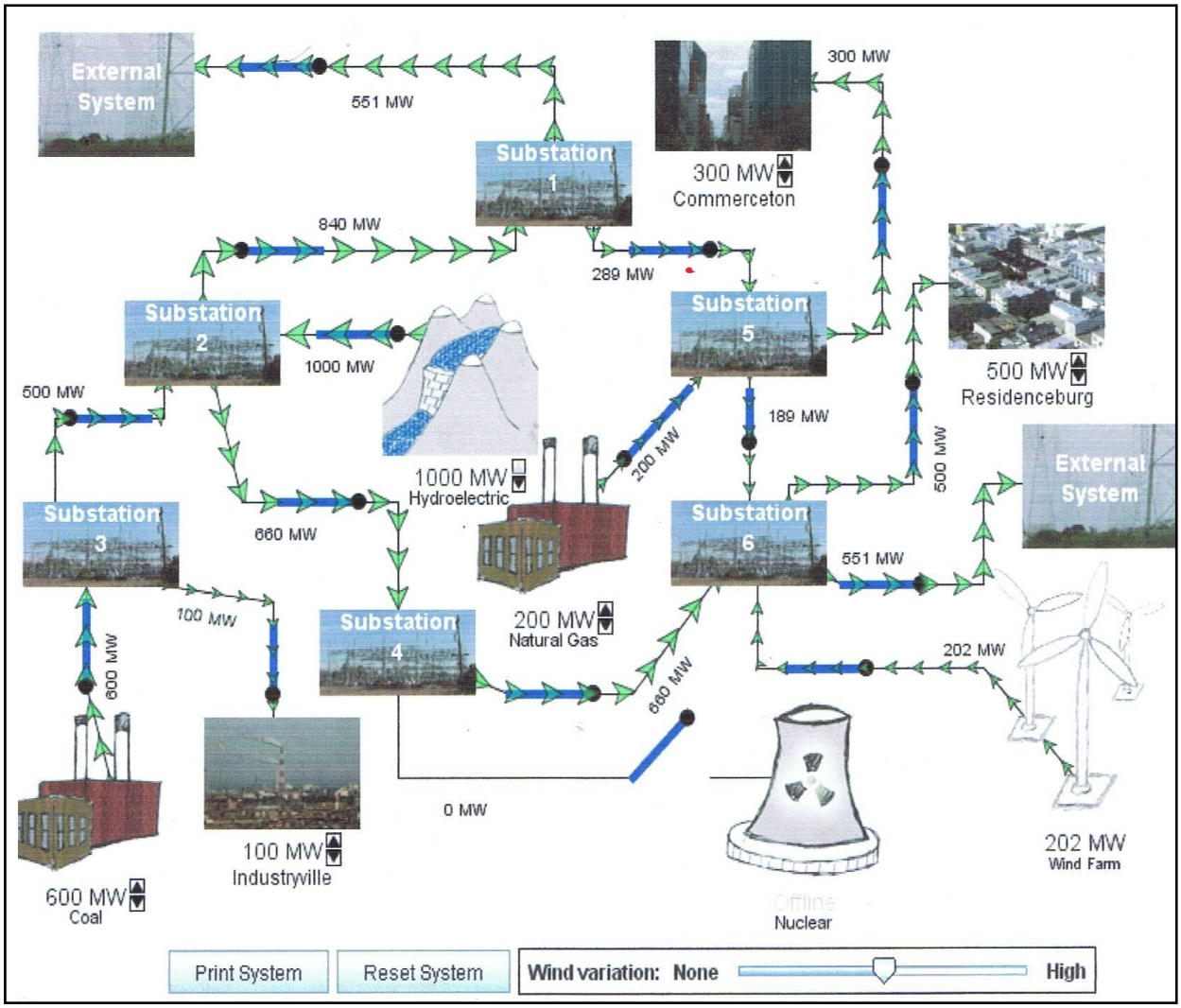
Your Opportunity to Participate in Electric Power Grid Study

Page 5. Description of Components in an Electric Power Grid

Assess the Status of Electric Power Grid

Schematic Diagram of Typical Electric Power Gri

The Schematic Diagram shown in the figure below illustrates the way that electricity is currently distributed from a producer of electricity through a substation to a customer. An active version of this schematic diagram can be obtained at the website http://www.oe.energy.gov/interactive_grid.htm. An animated diagram will allow the user to appreciate the source and flow of electric power consumption by various customers.



The implementation of smart grid technologies would enhance this electric power grid through the use of a communications system to enable smart circuit breakers, distributed generators, etc to quickly be activated to keep the electric power flowing when the grid experiences some difficulty or disaster.

Note: This diagram can be animated at the website http://www.oe.energy.gov/interactive_grid.htm

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

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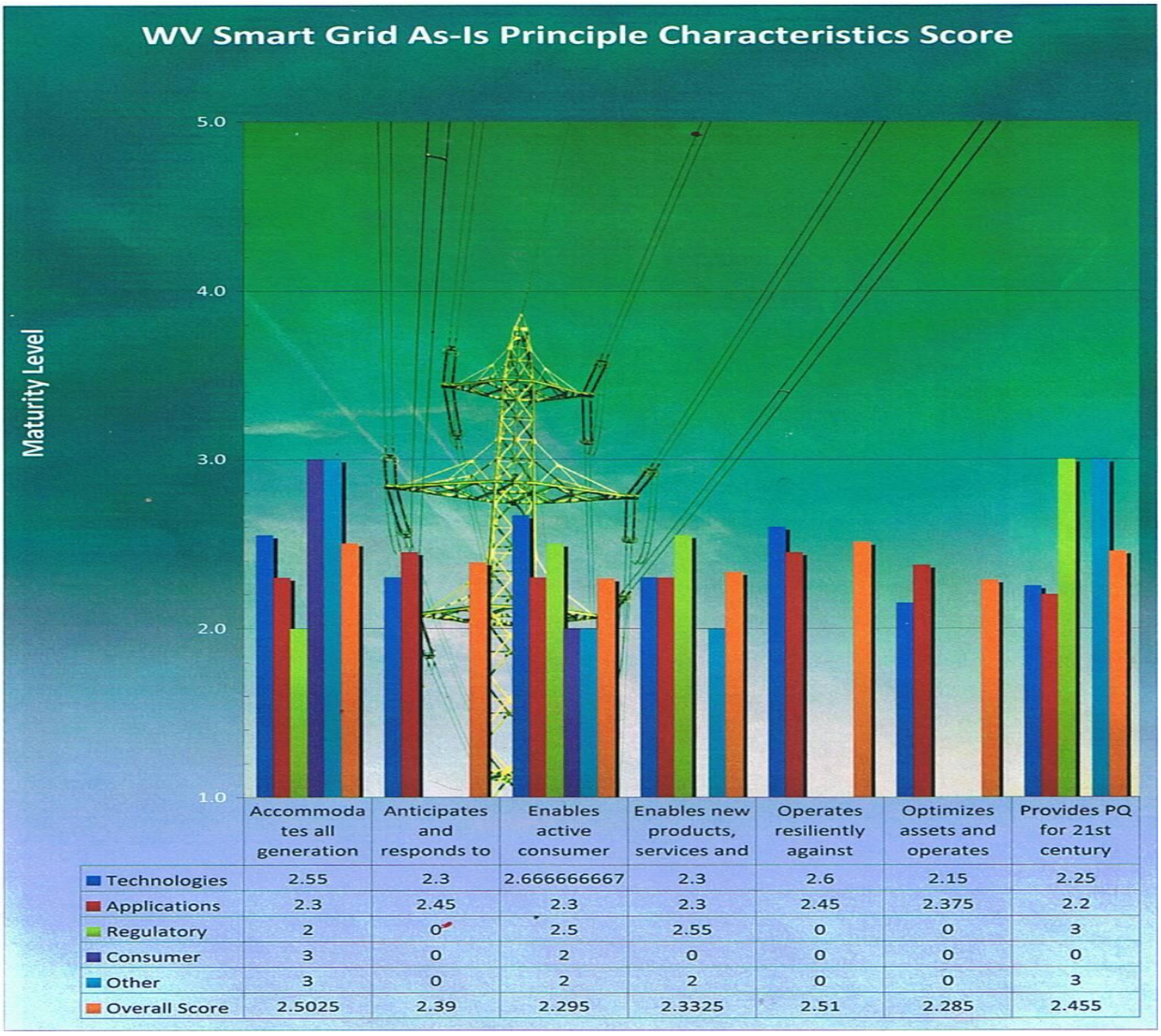
Page 6. Matrix of Seven Principal Characteristics to Define Maturity of Grid

Utilities, Regulators and Consumers

Various Opinions Needed to Define Electric Power Grid

The figure below shows that inputs will be obtained from five groups, including the **consumer**, for their opinion about seven principal characteristics of the electric power grid. These principal characteristics include 1) enables active consumer participation, 2) accommodates all generation and storage options, 3) enables new products, services and markets, 4) provides PQ for the 21st century needs, 5) optimizes assets and operates efficiently, 6) anticipates and responds to disturbances and 7) operates resiliently against attack and natural disaster.



	Accommodates all generation	Anticipates and responds to	Enables active consumer	Enables new products, services and	Operates resiliently against	Optimizes assets and operates	Provides PQ for 21st century
Technologies	2.55	2.3	2.666666667	2.3	2.6	2.15	2.25
Applications	2.3	2.45	2.3	2.3	2.45	2.375	2.2
Regulatory	2	0	2.5	2.55	0	0	3
Consumer	3	0	2	0	0	0	0
Other	3	0	2	2	0	0	3
Overall Score	2.5025	2.39	2.295	2.3325	2.51	2.285	2.455

Note: Tabulated numbers shown in the above table are not final results.

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

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Page 7. Assessment Survey of Electric Power Utilities

Utilities Evaluated for Five Levels of Maturity on Smart Grid

Example of Level 5 Category and Questions

APQC recently assessed the Smart Grid Maturity for eleven Electric Power Utilities. Example questions and possible responses from Level 5 of this assessment are shown below.

Smart Grid Maturity Model Initiative

Level 5 Innovating – Next Wave of Improvements

Section 5.8 Societal and Environmental: Three Questions

APQC

Smart Grid Maturity Model Initiative Assessment Survey Results

	Count	Frequency Percentage
5.8. Societal and Environmental		
A. Do you meet or exceed "triple bottom line" targets?		
a. no		
b. a little		
c. moderately		
d. to a great extent		
B. Are customers able to manage their own usage?		
a. no		
b. in development		
c. a little (available to 10% - 49% of customers)		
d. to a great extent (50% - 80% of customers)		
e. completely (> 80% of customers)		
C. Do you have tailored analytics and advice to customers?		
a. no		
b. in development		
c. a little (available to 10% - 49% of customers)		
d. to a great extent (50% - 80% of customers)		
e. completely (> 80% of customers)		

Note. The names of utilities and the results have been removed from this example for purposes of confidentiality.

West Virginia Smart Grid Implementation Plan (WV SGIP) Project

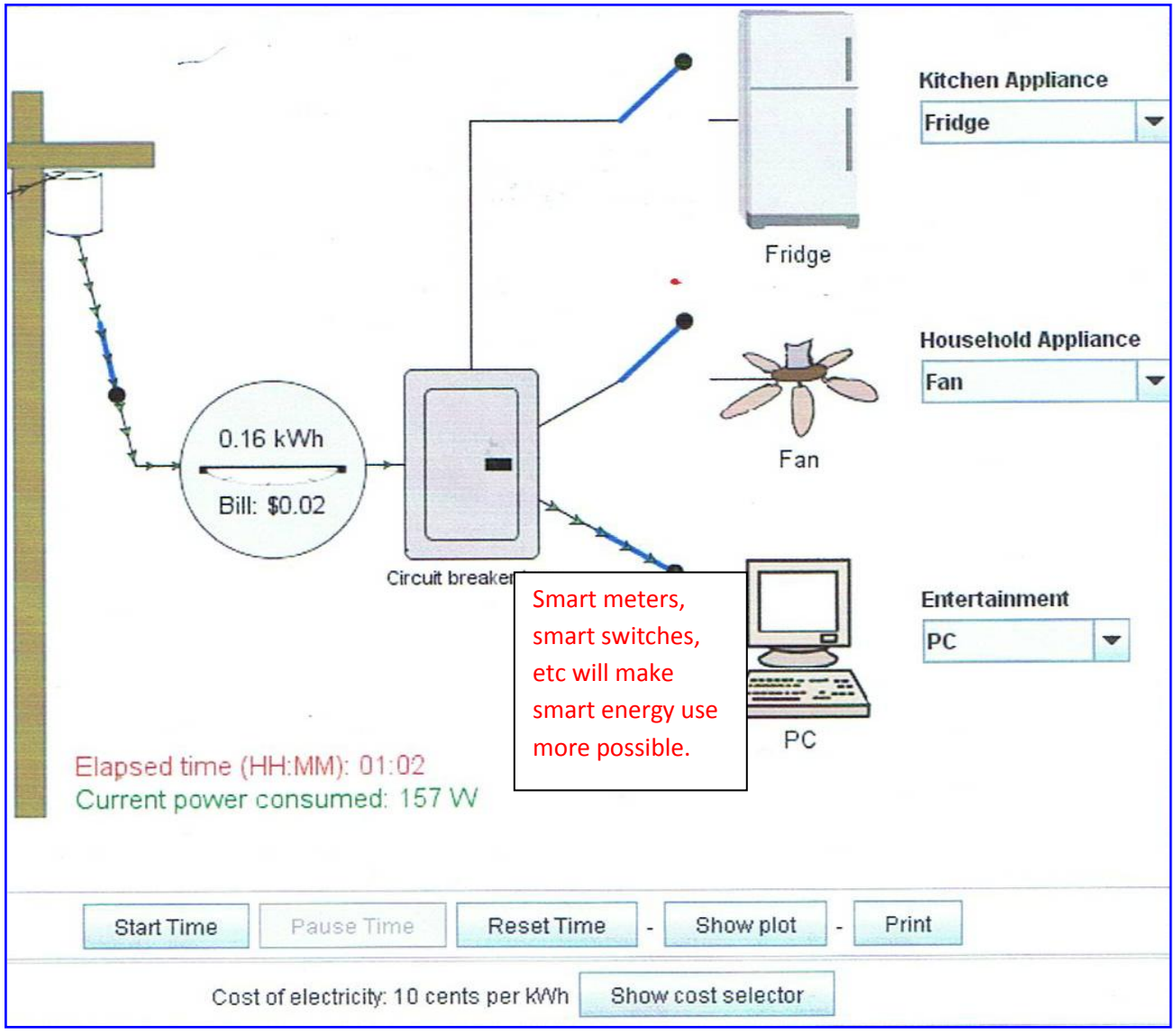
Your Opportunity to Participate in Electric Power Grid Study

Page 8. Description of Uses of Electric Power in a Home

Awareness of Electric Energy Consumption in Homes

Schematic Diagram of Typical Power Uses in Home

The schematic diagram shown in the figure below illustrates the way that electricity is currently distributed from a transformer on the utility pole into a home. An active version of this schematic diagram can be obtained by clicking on the website http://www.oe.energy.gov/interactive_grid.htm. An animated diagram will allow the home resident to appreciate the amount and cost of electric power consumption by various appliances, etc in the home.



Note: The implementation of smart grid technologies as noted in the diagram has been demonstrated to save the home resident about 10% on each monthly bill.

Attachment 4

Correlation between
WV SGIP Principal Characteristics (PC) and APERC Residential Responses (xR1, etc).

i.e, how to convert APERC Residential Responses to WV SGIP Principal Characteristics.

The matrix below converts the opinions by a residential person to four questions about the electric power utility, the regulatory agency, the company consumer and the societal world.
First, circle all of the UR, AR, CR and SR responses that have been marked by the residential person. Second, total the number of circled responses in each row as + points and – points. Then, determine the

WV SGIP	1	2	3	4	5	6	7	Score	Result
PC1 Yes	AR		CR				SR	+ points	net
PC1 No	CR						CR	- points	points
PC2 Yes					SR			+ points	
PC2 No	UR							- points	
PC3 Yes		CR	AR					+ points	
PC3 No				CR, UR	CR, UR		AR	- points	
PC4 Yes		UR				SR		+ points	
PC4 No						CR		- points	
PC5 Yes			UR				UR	+ points	
PC5 No		AR	SR					- points	
PC6 Yes					AR	AR		+ points	
PC6 No				AR		UR		- points	
PC7 Yes				SR				+ points	
PC7 No	SR	SR						- points	

net points as the mathematical sum of + points and - points.

This result is the value of the result for each of the seven principal characteristics for the WV SGIP Questionnaire.

Nomenclature:

WV SGIP Principal Characteristics (PC):
PC1: Consumer Participation? Yes or No.
PC2: Advanced Generation? Yes or No.
PC3: Modern Technology? Yes or No.
PC4: Power Quality? Yes or No.
PC5: Efficient Operations? Yes or No.
PC6: Quick Response? Yes or No.
PC7: Manages Problems? Yes or No.

APERC Residential Responses (xR1, etc):
About the Electric Power Utility:
UR1, UR2, UR3, UR4, UR 5, UR6, UR7
About the Regulatory Agency:
AR1, AR2, AR3, AR4, AR 5, AR6, AR7
About the Company Customer:
CR1, CR2, CR3, CR4, CR 5, CR6, CR7
About the Societal World:
SR1, SR2, SR3, SR4, SR 5, SR6, SR7

ps: The matrix is a draft version of the correlation matrix yet to be finalized.

Attachment 5

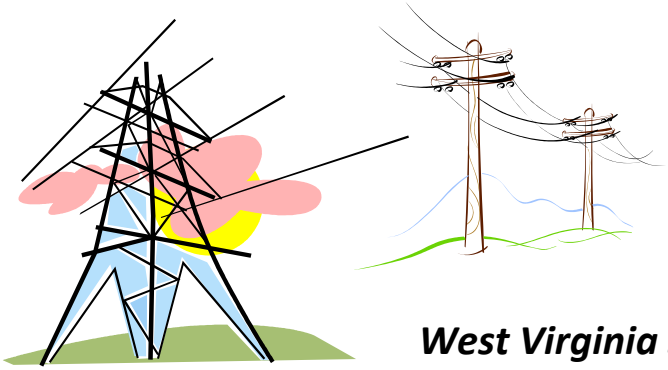
Further Simplified Opinion Questionnaire

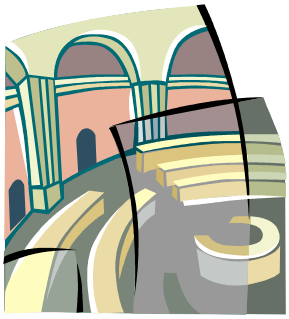
City of Morgantown
Neighborhood Coordinating Council

Express your opinion about current electric power service and potential for implementation of smart grid in West Virginia

1. Electric Power Company 1 2 3 4 5 [1 is poor and 5 is great]
Generators and Transmitters

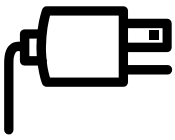
2. State Government 1 2 3 4 5
Legislators and Regulators



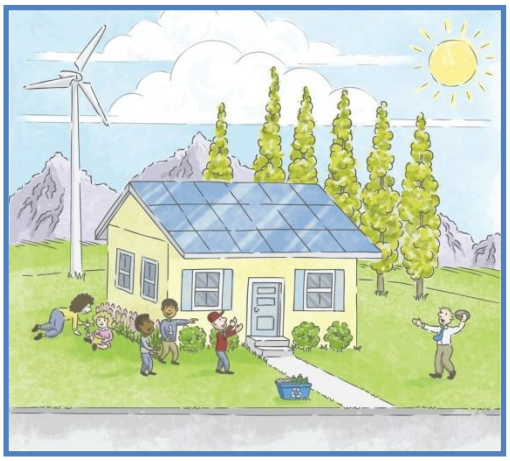


West Virginia Smart Grid Implementation Plan (WV SGIP) Project

3. Electric Power Customer 1 2 3 4 5 [1 is poor and 5 is great]
Commercial and *Residential*



4. Informed Resident 1 2 3 4 5



Please see article "W.Va. to Get First Statewide Smart Grid Plan" on back of sheet

W.Va. to Get First Statewide Smart Grid Plan

Posted Thursday, January 29, 2009 : 06:00 AM

A West Virginia Smart Grid Implementation planning process launched in July 2008 will be the first statewide Smart Grid plan in the U.S., according to Joe Miller.

Story by Pam Kasey
Email | Bio | Other Stories by Pam Kasey

MORGANTOWN — West Virginia is leading the charge for Smart Grid planning.

A West Virginia Smart Grid Implementation planning process launched in July 2008 will be the first statewide Smart Grid plan in the U.S., according to Joe Miller.

Miller is senior vice president at Maryville, Tenn.-based energy consultants Horizon Energy Group and a Sma Grid consultant to the U.S. Department of Energy's National Energy Technology Laboratory.

The study was an idea of Horizon President Steven Pullins and the NETL Modern Grid Initiative his company consults for, according to Jeff Herholdt, who heads up the West Virginia Division of Energy.

"They approached us about wanting us to partner with them on the first statewide Smart Grid study," Herhold said. "I think it's real neat."

By taking a statewide approach, the study incorporates a broader perspective than American Electric Power Allegheny Energy alone might take, Miller said, to include consumers' perspective and an analysis of regulato barriers.

"We're evaluating where West Virginia is today and where we see West Virginia going in 10 to 15 years with t Smart Grid," he explained. "Then we'll look at the gap that has to be bridged to get there."

That gap represents hardware and software, communications and intelligence that need to be put in place on the grid, he said.

Once those needs are identified, they'll calculate the costs and benefits.

"So our study will hopefully provide what it takes to get there, what it's going to cost, and the benefits that individual consumers are going to get out of this, that the utilities will get, and that society in West Virginia is going to enjoy as a group," Miller said.

The final report will include a timeline for milestones.

The document will help stakeholders over the coming year as the Public Service Commission of West Virginia works through a process of establishing a Smart Grid framework for the state, he said.

Herholdt said the study will detail the costs and benefits of the Smart Grid.

Should smart metering be employed, the Smart Grid will enable West Virginians to make intelligent choices about what time of day to actually do some of the household chores," Herholdt said.

The two sides are the operational efficiency of the electric grid and the opportunity for individuals to reduce energy use," he continued. "We're an electricity state. We're certainly hopeful that we can be a catalyst in innovations in electric transmission systems."

The West Virginia Smart Grid implementation Plan team includes Horizon Energy Group and the Division of Energy along with the PSC, West Virginia University, energy consultants SAIC and electric distribution utilities Appalachian Power and Allegheny Power, and is led by NETL.

The report is expected by May.

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Appendix

Post Comments

The following Comment was proposed to The State Journal by APERC for 'posting' about Smart Grid in order to further inform the public about the WV SGIP Project and to possibly receive additional input opinions from interested persons across the State.

"West Virginia customers of an electric power company have an opportunity to participate in a study to assess the current status of the electric power grid in West Virginia. Here's how:

A project is underway in West Virginia toward modernization of the electric power grid. This project, funded in part by the West Virginia Division of Energy, is called the West Virginia Smart Grid Implementation Plan project. A goal of this project is to assess the current status of the electric power grid in West Virginia. One group of participants in such an assessment is the residential consumers of electric power.

A brief four-question opinion questionnaire has been developed by the Advanced Power and Electricity Research Center at West Virginia University. The purpose of this questionnaire is to enable residential consumers of electricity in West Virginia to provide their input about their current electric power service. Persons who respond will gain an appreciation of the issues associated with implementation of the smart grid.

Residential consumers can participate by sending me your e-mail address. I will then e-mail the opinion questionnaire to you. When you have completed the questionnaire, you can return it to me by e-mail, or anonymously by US Mail. Thanks."