International Organization of Legal Metrology

Organisation Internationale de Métrologie Légale

Smart Metering in North America

Presented by
William H. Hardy, PhD
June 2, 2009

POWERMETRIX

UTILIMETRICS
Alliance for Advanced Metering & Data Management Solutions

OIML *Seminar on Smart Meters*
Brijuni, Croatia – 2-5 June 2009

About Utilimetrics

- *The Association for Smart Metering and Innovative Technologies* – Chicago, IL USA (utilimetrics.org)
- Represents North American Market
- Was Automatic Meter Reading Association (AMRA) started in 1987
- Members include Utilities (electric, gas, water), Vendors, Systems Integrators, Consultants, Other Stakeholders
- Standards group works with ANSI, IEEE, NIST, etc
- AUTOVATION® - Annual Conference and Exposition, Sept 13-16, Denver, Colorado USA

About TEC Powermetrix

- *Technology for Energy Corporation, Powermetrix Division*

- Manufacturer of Field Test Equipment for Metering Installations since 1994
  - Meter Registration
  - CT Accuracy
  - PT Accuracy
  - Wiring

About The Speaker

- William H. Hardy, PhD
  - Background is high accuracy instrumentation
  - Voting Member C12
    - Active in C12.1, C12.10, C12.20, C12.24
      - Chairman Harmonics working group
  - IEEE SA
    - 1459 Electricity Measurements

North American Electricity Regulation

Federal Electric Regulatory Commission (FERC) – regulates interstate transmission and wholesale transactions

Measurement Canada – responsible for ensuring the integrity and accuracy of measurement in the Canadian marketplace

State/Provincial Public Service Commissions/Public Utility Commissions – regulate investor owned utilities at the retail level

Government-Owned Utilities and Cooperatives are largely self regulated

Electricity Deregulation

Uncoupling of energy production, distribution and transmission

Distribution and transmission to remain regulated

There have been proposals for “Competitive Metering”

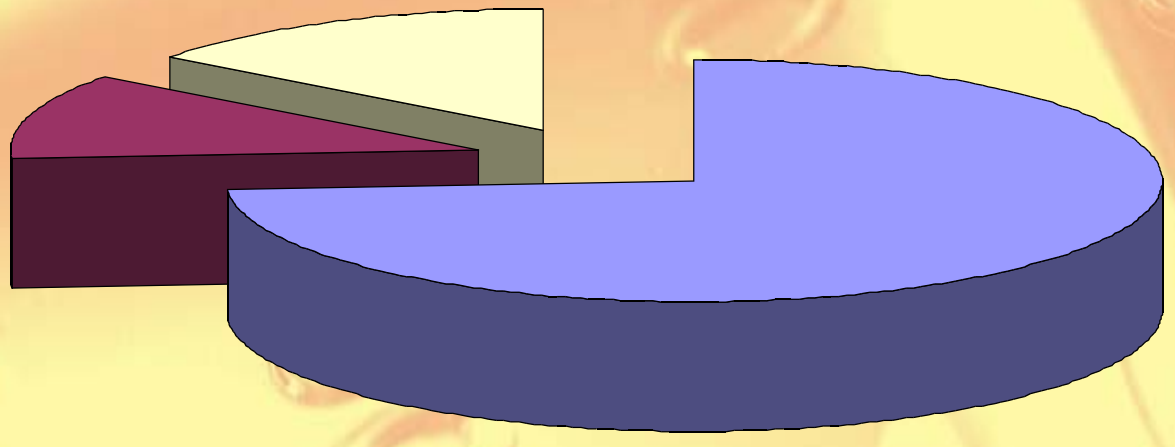
Electricity Suppliers

Utilities	3,124
Investor-Owned Utilities	222
Rural Cooperatives	875
Municipal Systems	1,885
Public Power Districts	73
State Projects	55
Federal Agencies	14
Non-Utilities	4,247
Non-Utilities (excluding EWGs)	4,103
Exempt Wholesale Generators (EWGs)	144
Total	7,371

Ultimate Customers Served

Government Owned Utilities
14.6 %

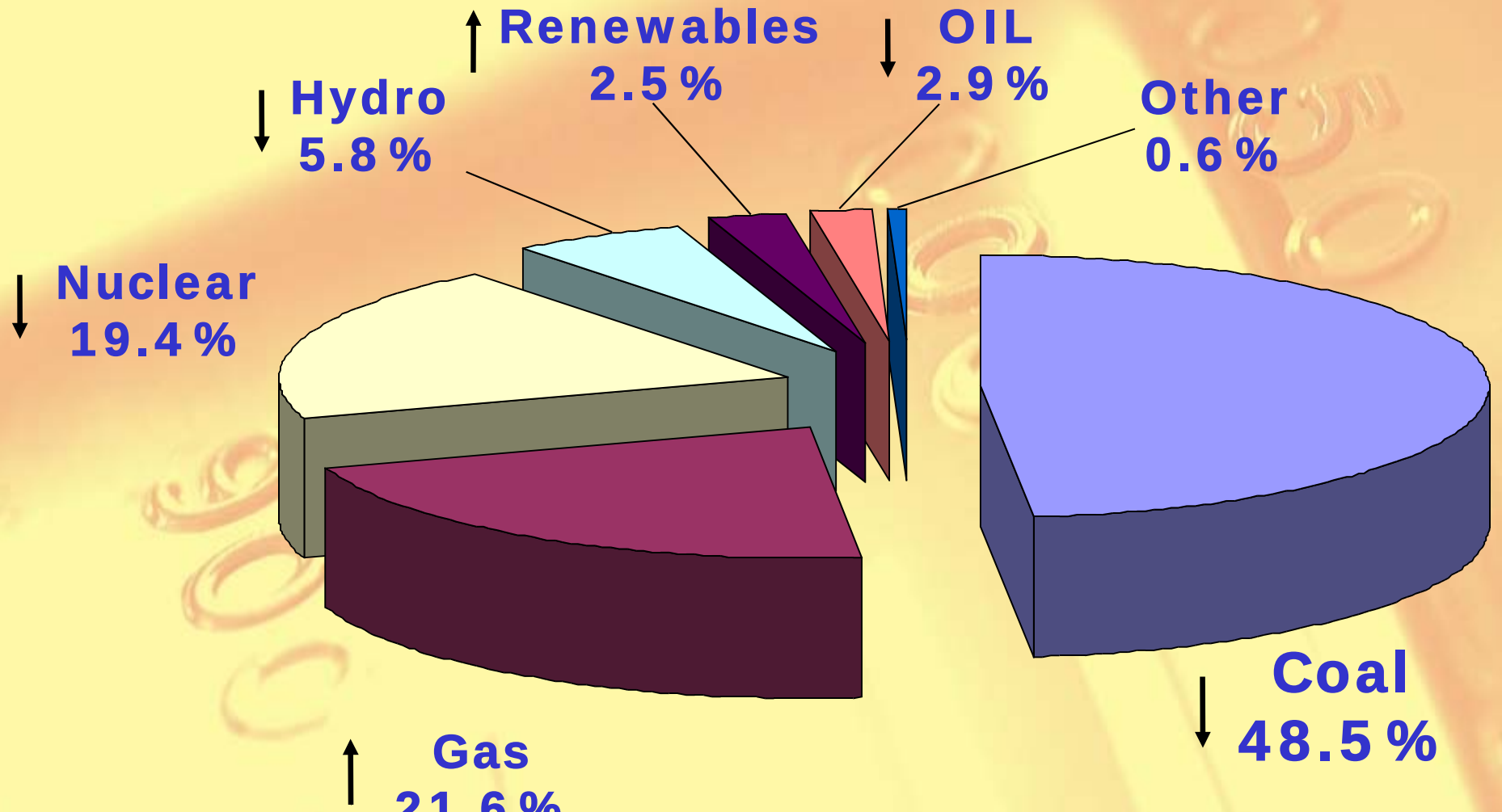
Coops
11.6 %



Investor Owned Utilities
73.8 %

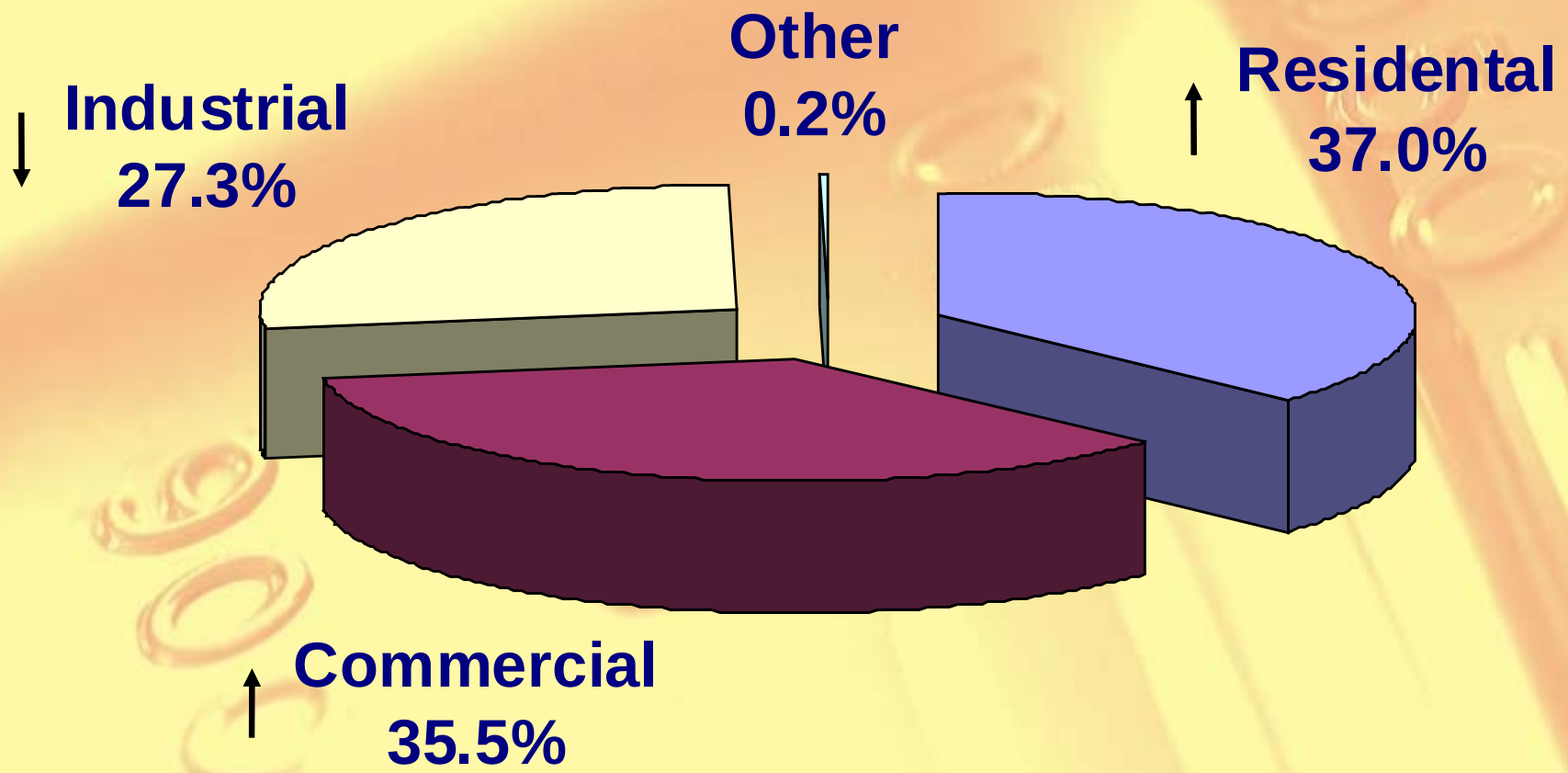
Current Generation Mix

2007 Data



Electricity Sales to Ultimate Customers

2007 Data



Metrological Control of Meters

- Type approval
- States have responsibility through Public Service Commissions (PSCs) supervision
- PSCs regulate the Utilities
- Meter manufacturers perform actual type verification tests.
- Verification
- Limited testing at utility for new meters
- Subsequent statistical sampling of meter lots as a function of time
- Witnessed verification to resolve disputes

North American Metering

Relevant Standards Committees

American National Standards Institute (ANSI) C12 Electricity Metering Secretariat – National Electrical Manufacturers Association (NEMA)

IEEE ASC57 Committee

ANSI C57.13 Instrument Transformers

Accredited Standards Committee (ASC)

- Requirements:
  - Due process
  - Openness
  - Balance
  - Written Procedures
  - Appeal Process
- Interested and affected parties
- C12 and C57 are composed of:
  - Manufacturers
  - Utilities
  - Associations

ANSI Standards Process is Generally Reactive not Proactive

ANSI Metering Standards

- ANSI C12.1-Code for Electricity Metering
- ANSI C12.7-Requirements for Watt Hour Meter Sockets
- ANSI C12.10-Electromechanical Watt hour Meters
- ANSI C12.11-Instrument Transformers for Revenue Metering
- ANSI C12.20-0.2 and 0.5 Accuracy Class Meters

ANSI Meter Communications Standards

- ANSI C12.18 Protocol Specification for ANSI Type 2 Optical Ports
- ANSI C12.19 Utility Industry End Device Data Tables
- ANSI C12.21 Protocol Specification for Telephone Modem Communication
- ANSI C12.22 Protocol Specification for Interfacing to Data Communication Networks
- ANSI C12.23 (under development) AMR Device Compliance Test Standards

ANSI C12 Current Focus

Metrology

C12 only deals with 60Hz sinusoidal waveforms

Only Watts have a legal definition in US

WG recently established to address Harmonics

Under real world conditions different manufacturer's meters get different answers for VA, VAR and Power Factor

Revenue Implications

PSCs often don't understand technical issues

PSCs have approved rates based on VA, VAR and Power Factor

ANSI C12 Current Focus

Communication Protocols

C12 and IEEE standards efforts harmonized

C12.18, C12.19, C12.21, C12.22 all approved

WGs for C12.23 and IEEE P1704 now focusing on validation protocols for communications standards

Field Testing of Metering Installations

WG established to address field testing

Meter, CTs, PTs and wiring

IEEE Smart Grid Standards

IEEE / SCC31
Standards Working Groups

- **IEEE 1377:**
  - "Utility Industry Metering Communication Protocol Application Layer Standard (End Device Data Tables)"
  - Same as ANSI C12.19 utilizing ANSI C12 SC17 WG2
- **IEEE 1701:**
  - "Optical Port Communication Protocol to complement the Utility Industry End Device Data Tables"
  - Same as ANSI C12.18 utilizing ANSI C12 SC17 WG4
- **IEEE 1702:**
  - "Telephone Modem Communication Protocol to complement the Utility Industry End Device Data Tables"
  - Same as ANSI C12.21, utilizing ANSI C12 SC17 WG4
- **IEEE 1703:**
  - "Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables"
  - Same as ANSI C12.22, utilizing C12 SC17 WG1
- **IEEE 1704**
  - "Utility Industry End Device Communications Module"
  - The mechanical characteristics of the communication module defined in IEEE 1703.
  - No corresponding ANSI Standard
  - Work is about to start.
- **IEEE 1705:**
  - "Compliance Testing Standard for Utility Industry metering communications protocol standards"
  - Was intended to be the same as ANSI C12.23, but may not be the same due to unilateral change in scope made by ANSI C12 SC17WG3.
  - Stalled.

Other IEEE Standards

IEEE 1459-2000 Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Non-Sinusoidal, Balanced, or Unbalanced Conditions

- Has not been widely accepted in Metering Community in US
- Viewed as a theoretical approach as opposed to an economically implementable approach

Meter Physical Formats

Transformer Rated Meters – Class 20

Meter Physical Formats

Self Contained Meter

Self Contained Meter Socket

Some ANSI - IEC Meter Differences

- Round and socket mounted
- Weather tight
- Wide temperature performance
- Usually powered from “A” phase
- Class designator - maximum current rating

- Rectangular and bottom connected
- Not weather tight
- “indoor” temperature requirements
- Powered from any phase
- Class designator – nominal current rating

Common NA Practices

- Non-Blondel forms common for residential applications
- Self Contained – Class 100, Class 200, Class 320 (Accuracy 1.0% to 2.5%)
- Transformer Rated – Class 10, Class 20
- (Accuracy 0.5% and 0.2%)
- Accuracy only verified under 60Hz sinusoidal conditions PF = 1.0 and PF=0.5
- Meter often contains many auxiliary devices
  - Type approval often done without auxiliary devices in place
- All standards are voluntary not mandatory

ANSI - IEC Meter Similarities

- Both Meter types specify starting current, power factor, and accuracy specifications over current range, but specifications not exactly the same
- Similar Electro-static discharge specifications, using IEC EMC standards
- Similar (but some detail differences in) EMC immunity specifications
- Both have magnetic interference tests
- Optical port details different, but probes can be make that can be used with either

Smart Grid/Smart Meters Initiative

What is the “Smart Grid” in North America?

Everything to Everyone

Smart Grid/Smart Meter Initiatives

- Smart Meter activity grew out of AMR programs
- AMR pilot programs have been around since the early 1990's (and even earlier)
- Later in the 1990's full deployments started to be seen
- AMR was 1-way and not always a fixed network (drive by AMR)
- 2-way AMR was the birth of Advanced Meters

Smart Grid/Smart Meter Initiatives

- Advanced Meter activity started with 2-way AMR used for remotely reprogramming meters
- Firmware upgradeability was then added and the concept of an Advanced Metering Infrastructure (AMI) was born
- As the network infrastructure became advanced, the meters were on the brink of becoming smart

Smart Grid/Smart Meter Initiatives

- Smart Meters have become an endpoint to measure and report information to the utility, but also to the customer
- Smart Grid concept has grown to encompass Smart Meters as just one of the many types of endpoints
- Driven by the *Energy and Security Independence Act of 2007*
- Implementation of Smart Grid/Smart Meter Deployments is decided by individual utilities and their Public Service Commissions

Smart Grid/Smart Meter Initiatives

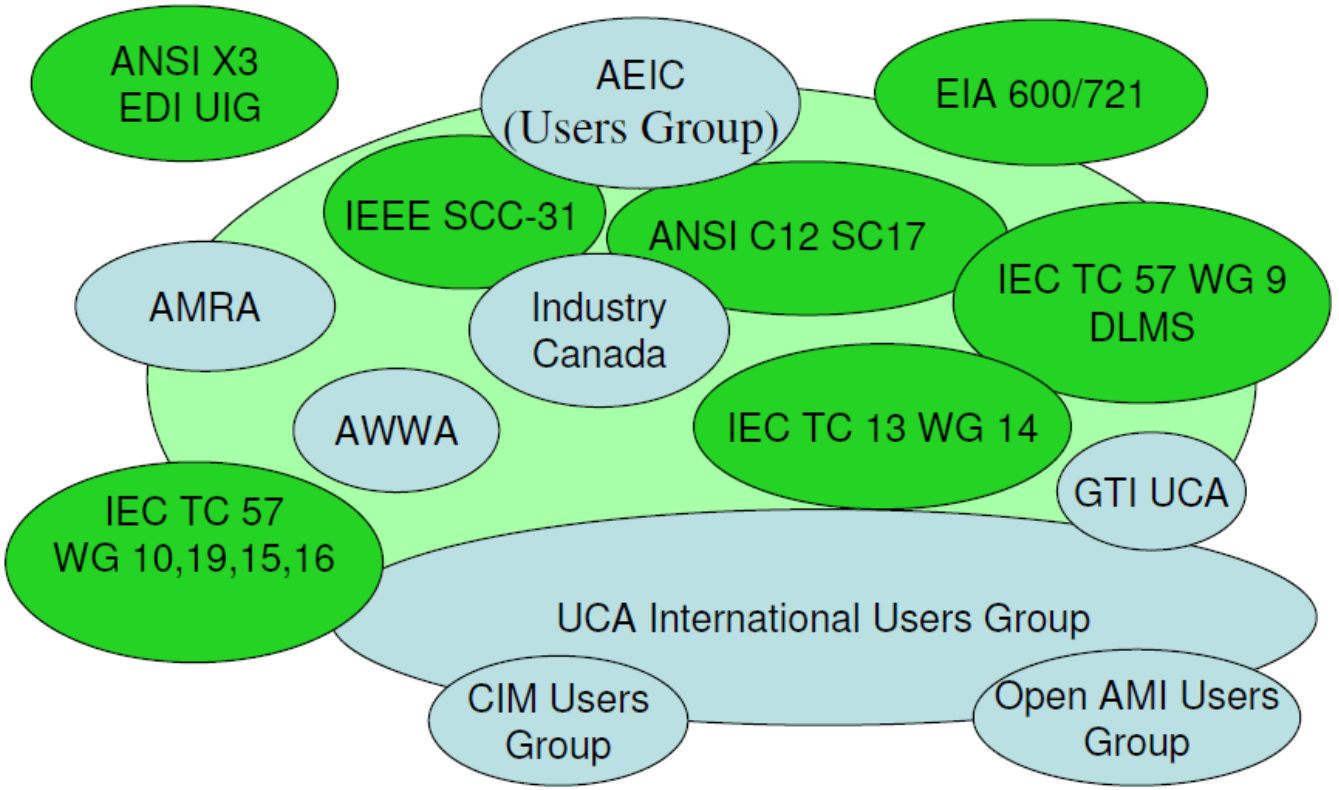
- The $4.5B Stimulus funding from the American Recovery and Reinvestment Act of 2009 has created rush of activity
- Many organizations have formed working groups to address the issues
- Smart Grid emphasis adds complexity to the Smart Meter standards work
- Drive to implement is outdistancing standards activities and technology

Smart Grid/Smart Meters Meetings

Meeting	Sponsor	Date
Smart Grid Interoperability Standards Roadmap Workshop	NIST/EPRI	April 28-29, 2009
Smart Grid Summit	Chartwell	May 7-8, 2009
Smart Grid Interoperability Standards Roadmap Workshop	NIST/EPRI	May 19-20, 2009
Revolutionizing the Smart Grid	Active Communications International	May 19-20, 2009
Smart Grid Interoperability Standards Project	IEEE SCC21/Intel	June 3-5
GridWise Expo/Connectivity Week	Clasma	June 8-11, 2009
Smart Grid Policy & Implementation Forum	Platts	June 23 - 24, 2009
National Town Meeting on Demand Response and Smart Grid	Demand Response Coordinating Committee	July 13-14, 2009

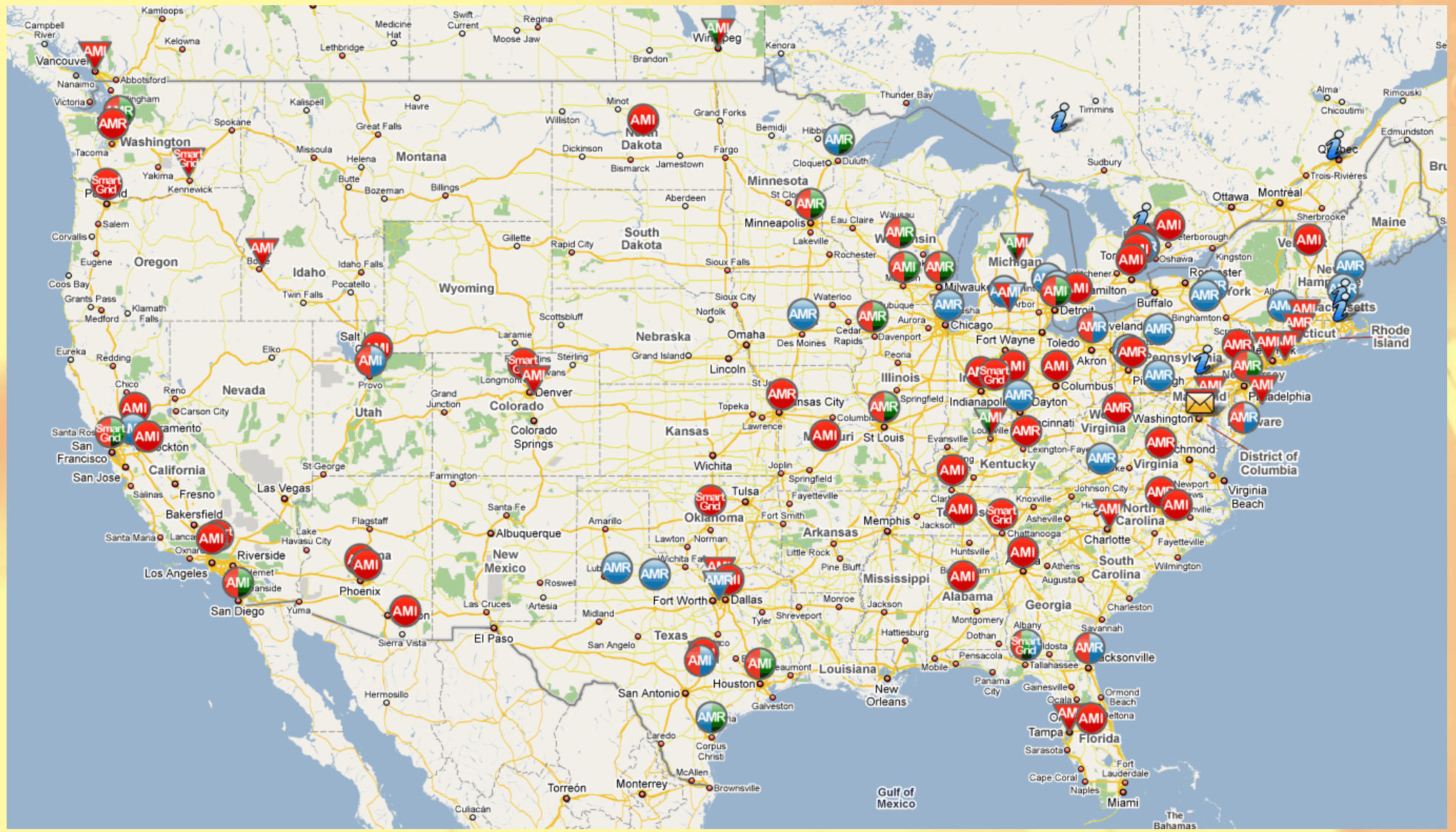
Smart Grid/Smart Meter Initiatives

Standards Development Initiatives: "The Radar Screen"



Courtesy: Electric Power Research Institute, Inc.

Smart Grid/Smart Meters Initiative



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Thank You

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