



EPRI / SNL PV-Storage Inverter Communication Project

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Electric Power Research Institute (EPRI)

EPRI Smart Inverter links:

- http://my.epri.com/portal/server.pt?Abstract_id=000000000001021674
- <ftp://PVCommunication:Member@ftp.epri.com/>

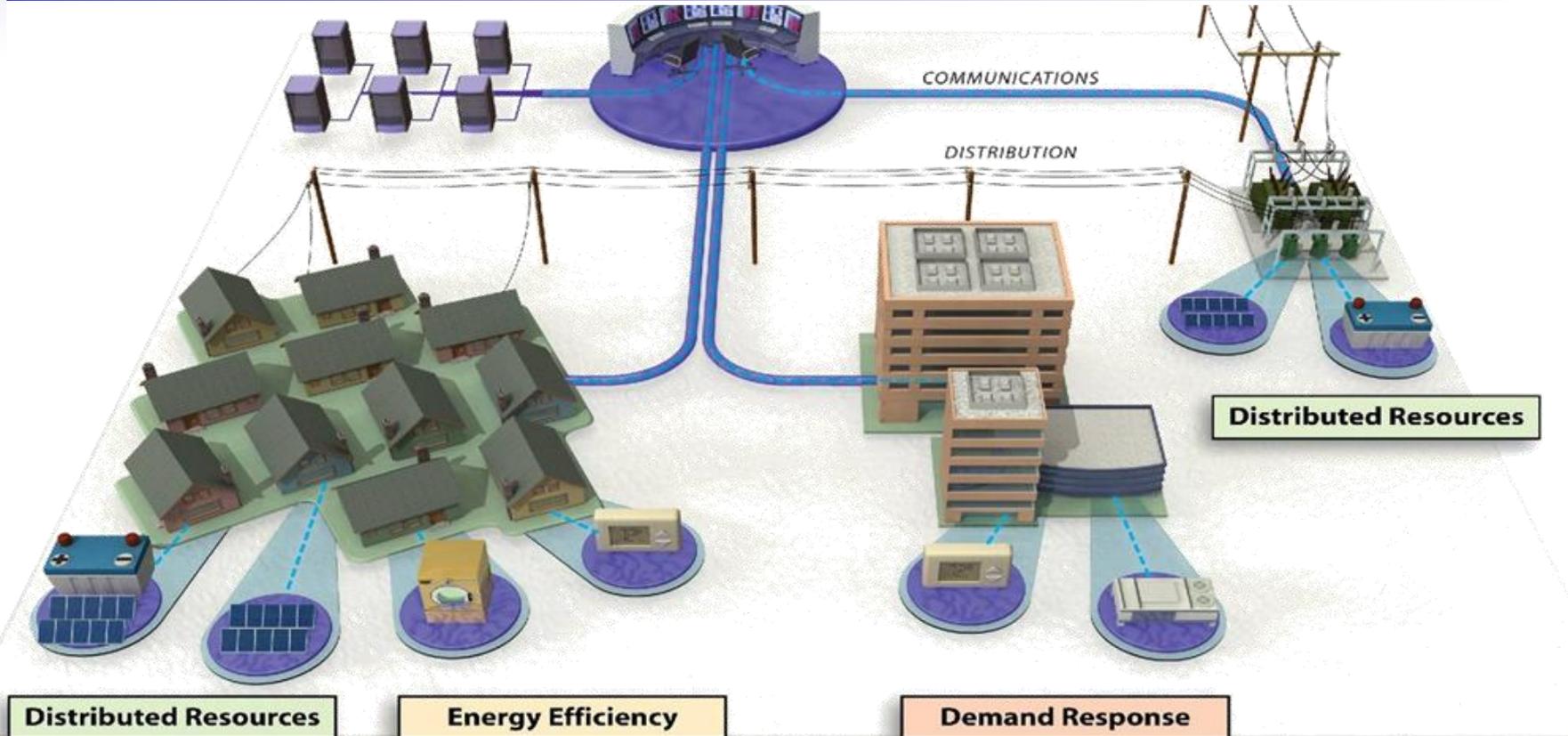
Al Hefner

National Institute of Standards and Technology

NIST Smart Grid and PAP7 links:

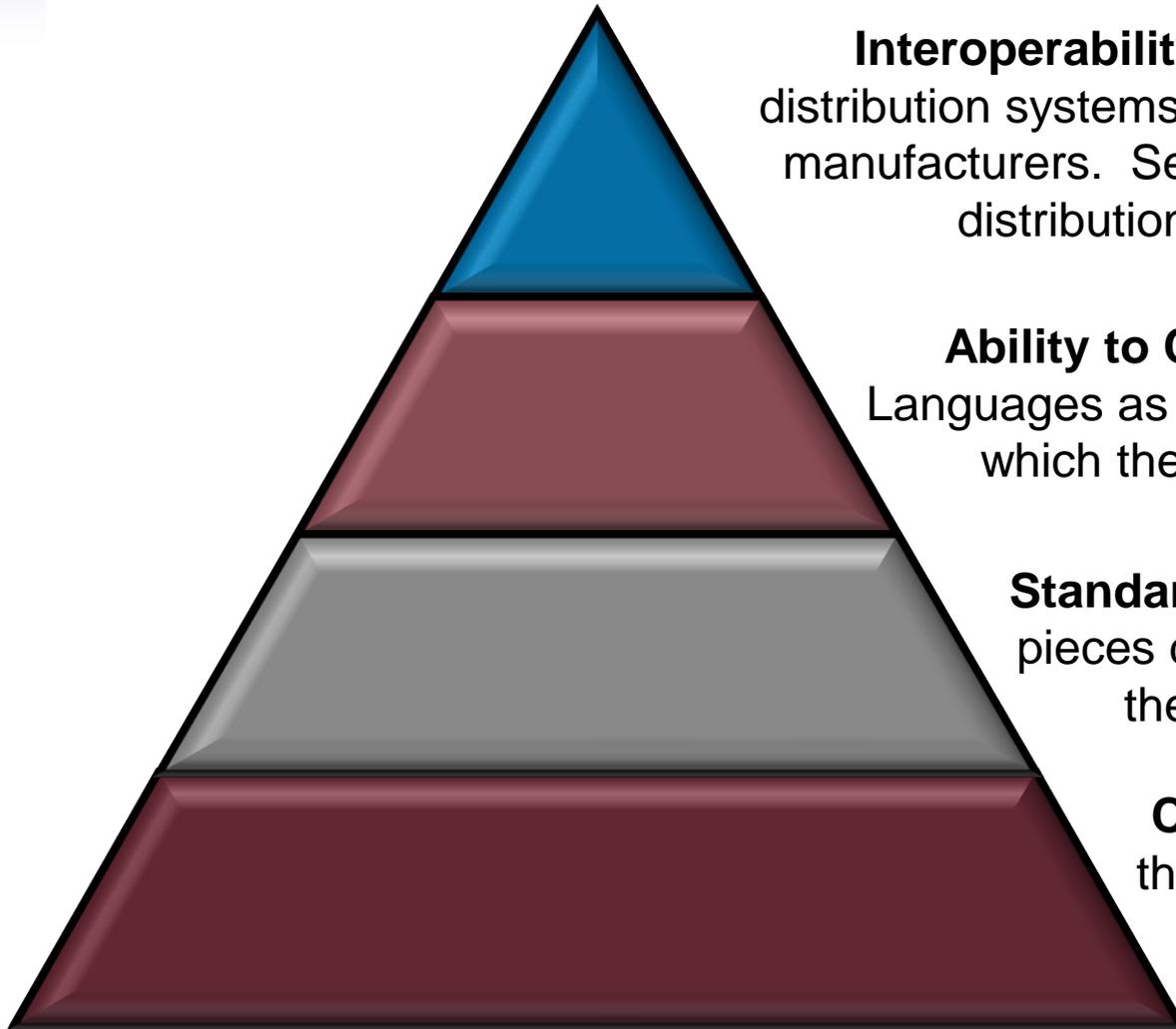
- <http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP07Storage>
- <http://www.nist.gov/smartgrid/>

A Vision for “Smart Inverters”



Communication-Connected Distributed Solar and Storage Systems Serving as Beneficial Distribution System Assets

Breaking Down the Need



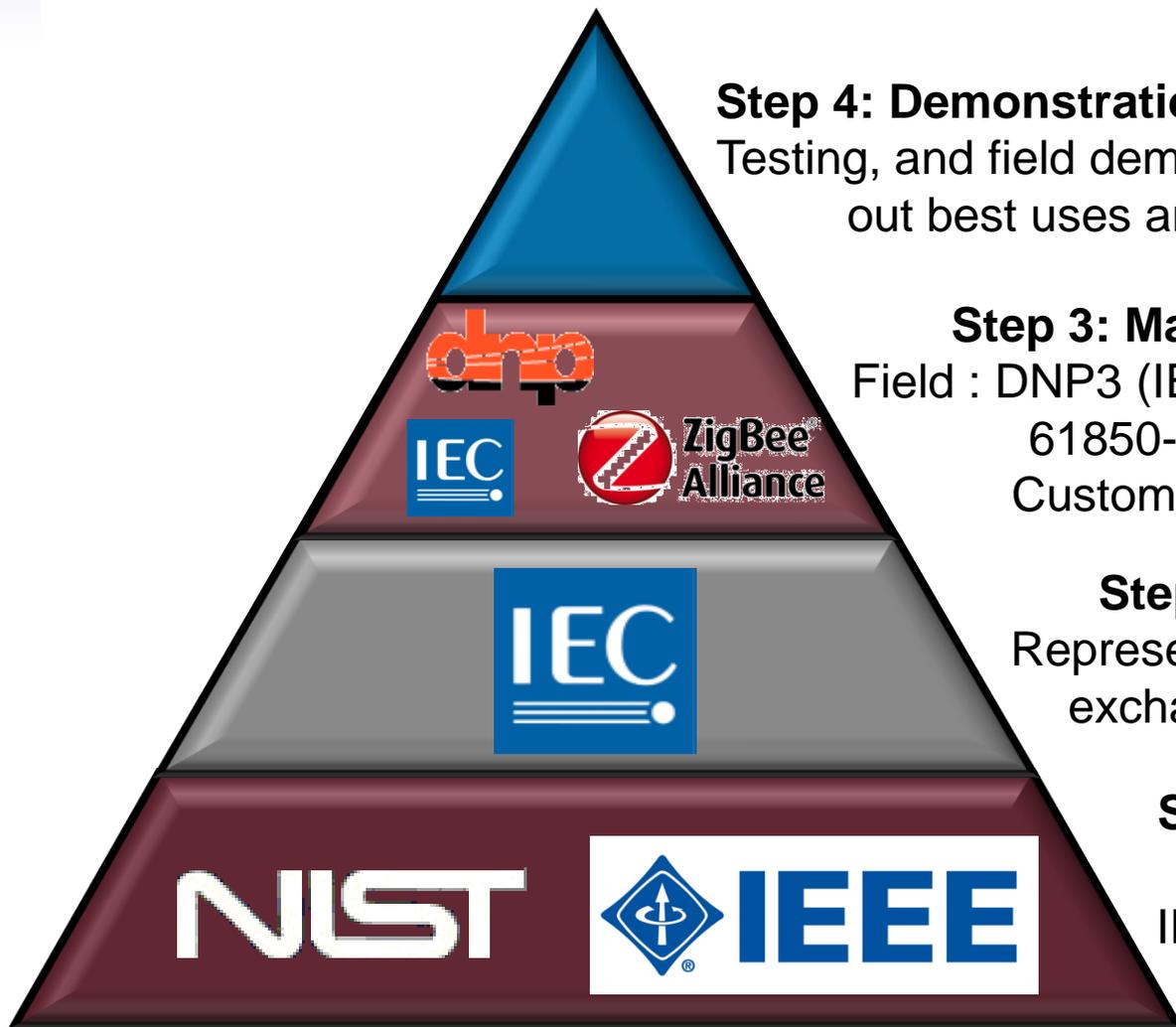
Interoperability – Many devices in distribution systems. Diverse types, diverse manufacturers. Serving as active parts of distribution management.

Ability to Communicate - Standard Languages as appropriate for the domain in which the devices are integrated.

Standard Information – What specific pieces does the Utility need to pass to the devices and visa-versa?

Common Functions – What are the basic grid-supportive functions that distributed resources are expected to perform?

Working Back toward the Goal of Interoperability



Step 4: Demonstration – Prototyping, Laboratory Testing, and field demonstration projects to prove-out best uses and to determine value.

Step 3: Mapping to Protocols –
Field : DNP3 (IEC 61400-25-4), MMS (IEC 61850-8-1), Webservices,
Customer : SEP 2.0, others

Step 2: Standard Model -
Representing the Information to be
exchanged on IEC 61850-7-x

Step 1: Identifying Common Functions – Using NIST, IEEE, SunSpec, & the interest group to identify needs

Energy Independence and Security Act (2007)

In cooperation with the DoE, NEMA, IEEE, GWAC, and other stakeholders, **NIST** has “primary responsibility to **coordinate development of a framework** that includes protocols and model standards for information management **to achieve interoperability of smart grid devices and systems...**”



American National Standards Institute



I E T F



US Government Roles in Smart Grid

Federal



Office of Science & Technology Policy; National Economic Council; & Council on Environmental Quality



INTERNATIONAL TRADE ADMINISTRATION



Smart Grid Task Force / National Science & Technology Council
Smart Grid Subcommittee

Other Federal Agencies



FERC – NARUC
Smart Response Collaborative

State



Public Utility Commissions

- **Framework and Roadmap**
 - published January 2010
 - Smart Grid Reference Model
 - identified 75 key standards
 - 16 Priority Action Plans (PAP)
- **Cyber Security Document**
 - published August 2010
- **SG Interoperability Panel (SGIP)**
 - public-private partnership
 - created November 2009
 - 600 member organizations
 - 1700 participants
- **Coordinates over 20 Standards Development Organizations**

<http://www.nist.gov/smartgrid/>

NIST Special Publication 1108

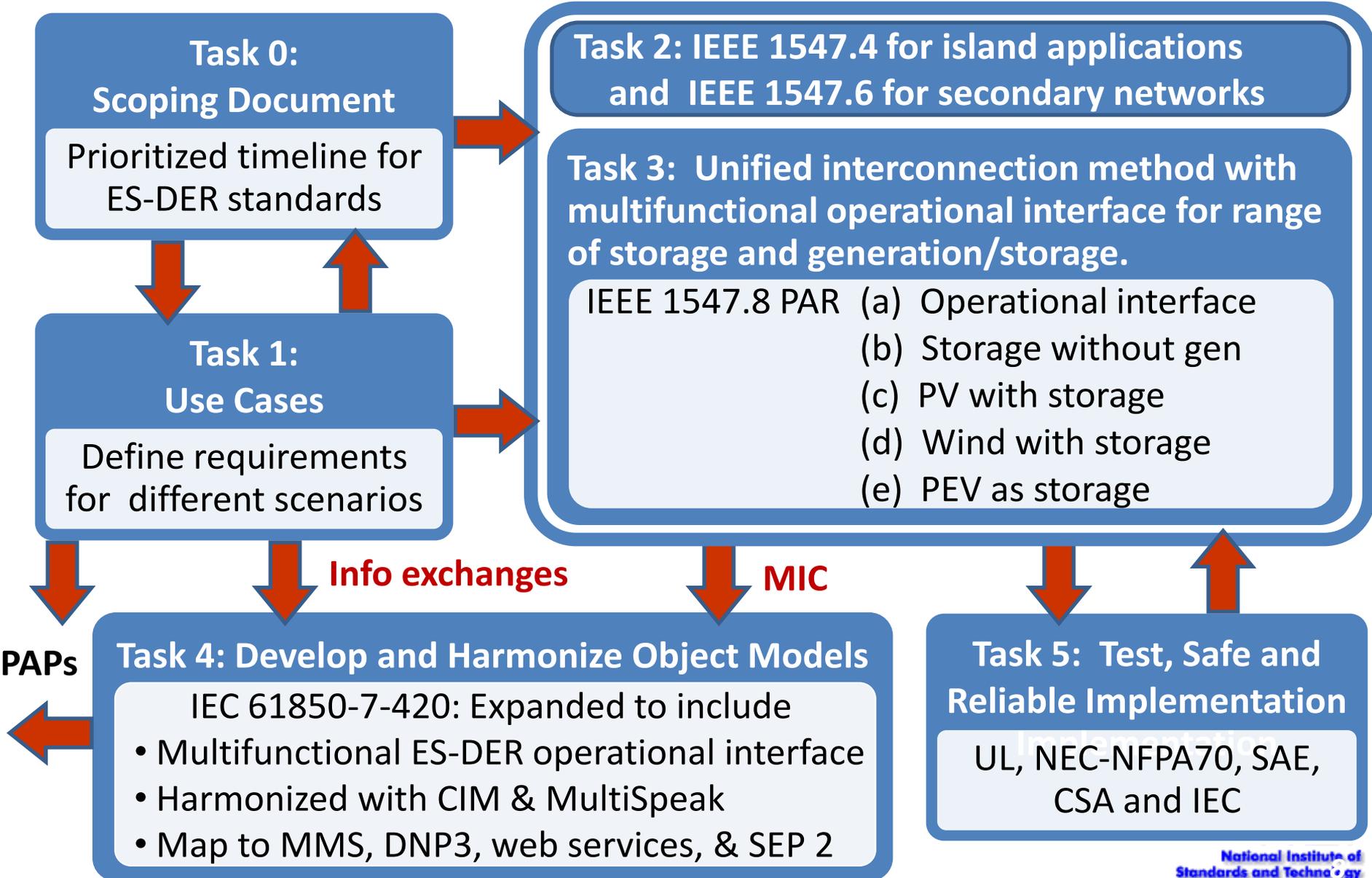
**NIST Framework and Roadmap for
Smart Grid Interoperability
Standards,
Release 1.0**

Office of the National Coordinator for Smart Grid Interoperability

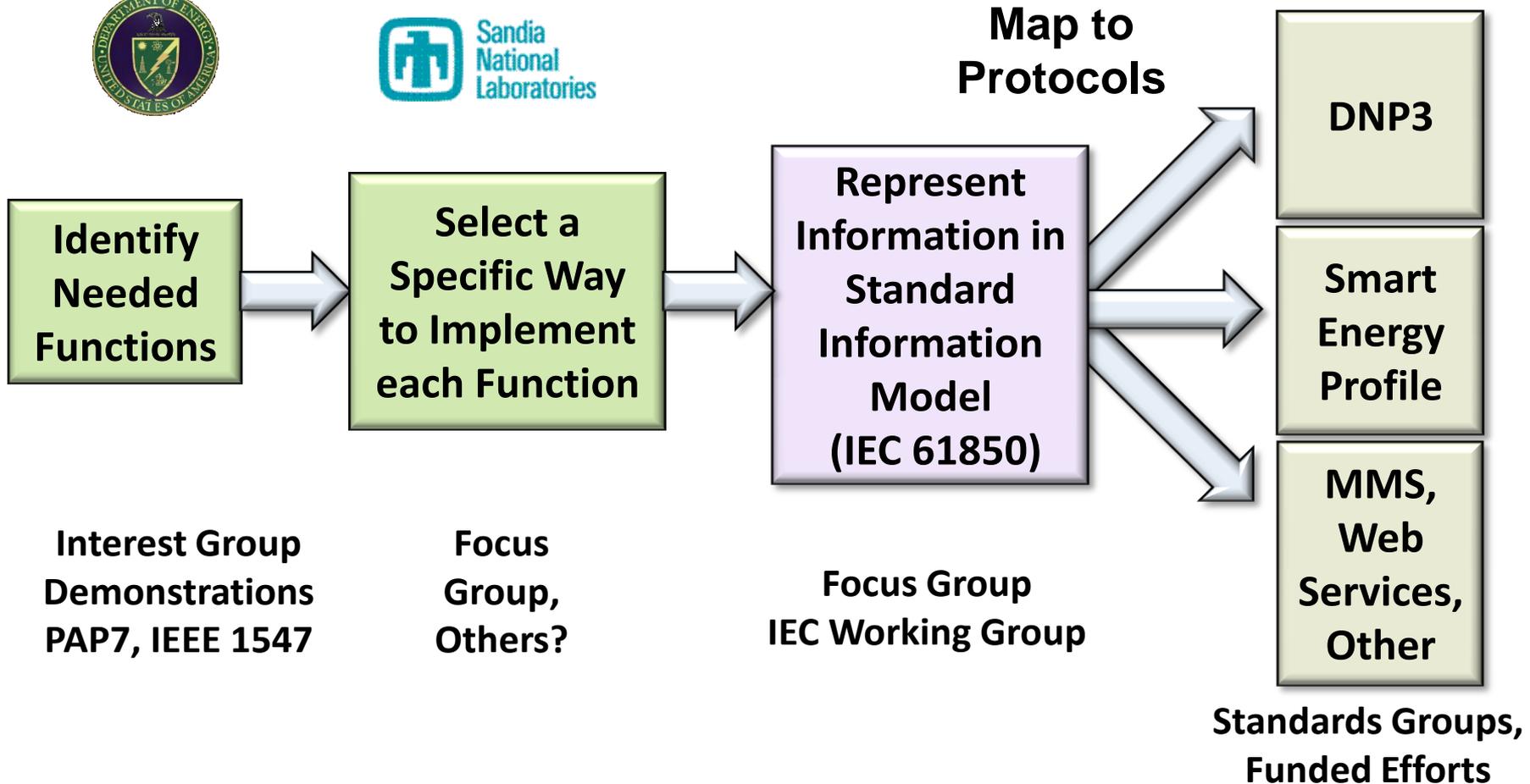
NISTIR 7628

**Guidelines for
Smart Grid Cyber Security:
Vol. 1, Smart Grid Cyber
Security Strategy, Architecture,
and High-Level Requirements**

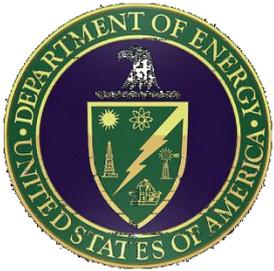
PAP 7: Distributed Generators and Storage



Role of EPRI/SNL Smart Inverter Initiative

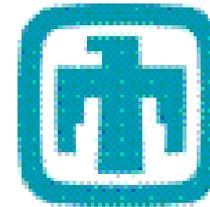


Collaborative Industry Initiative Formed in 2009



EPRI

ELECTRIC POWER
RESEARCH INSTITUTE



**Sandia
National
Laboratories**

More than 450 individuals contributing to the initiative

- 40 PV & Storage equipment providers
- 60 utilities
- 12 National labs and research organizations

Coordinating with PAP7

To Align with IEEE 1547

Functions Addressed and Planned Next

Phase 1 Functions:

- Connect/Disconnect – Non Islanding
- Max Generation Level Control
- Smart VAR Management and PF
- Storage Management
- State/Status Monitoring
- Event Logging
- Time Adjustment

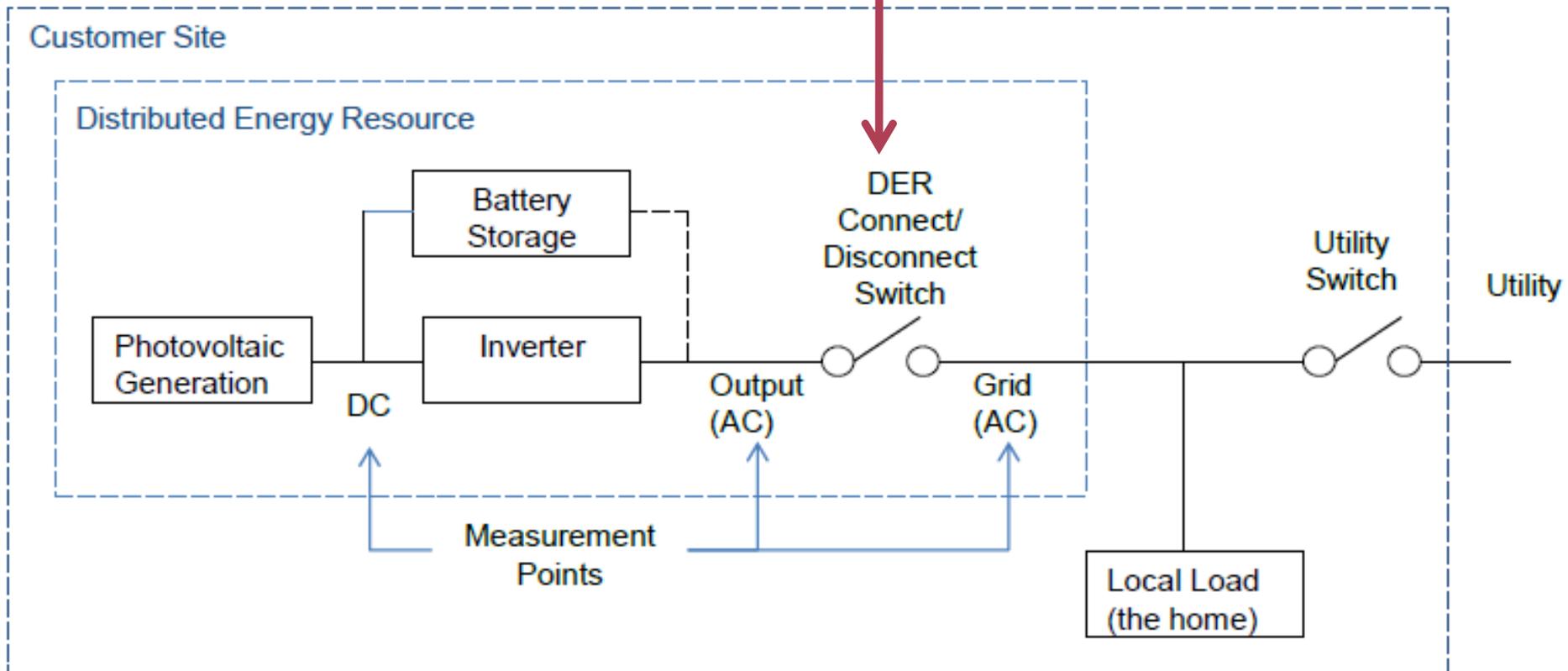
Phase 2 Functions:

- Voltage Sag Ride-Through
- Watt-Voltage Management (transient and steady-state)
- Watt-Frequency Management
- Islanding
- Additions to State/Status Monitoring

Connect/Disconnect

Management of this Switch

- Not the same as Power = 0
- Randomizable



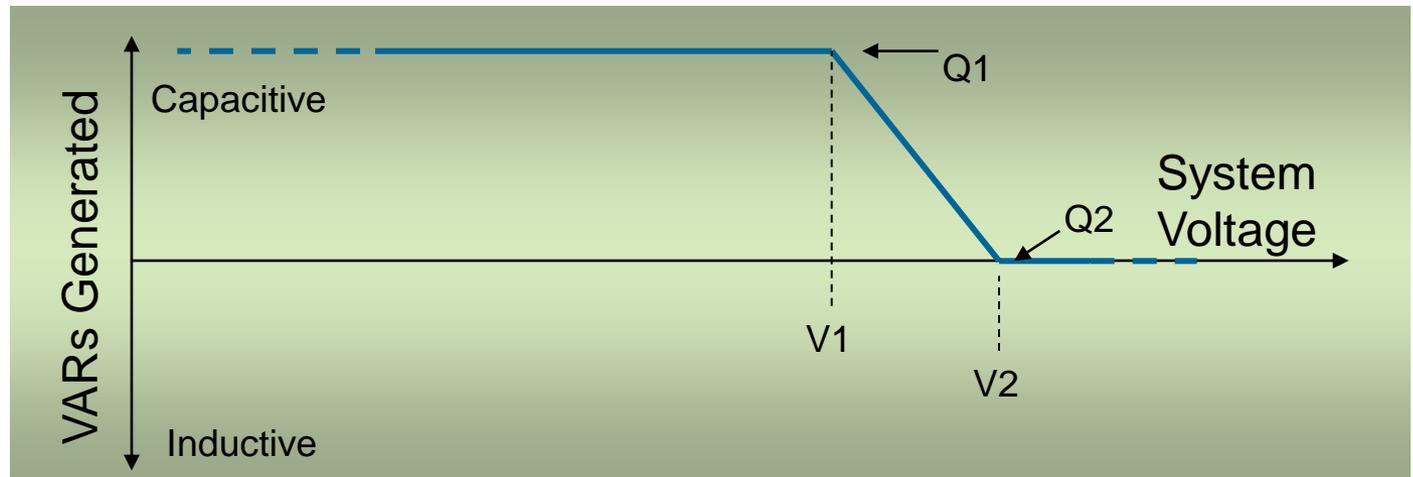
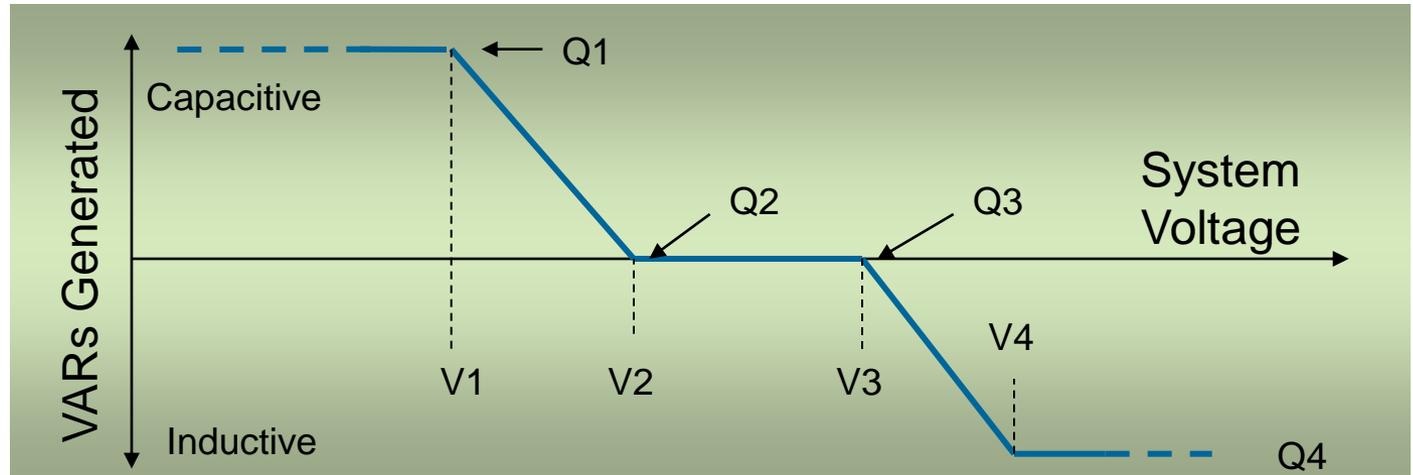
Advanced Volt-Var Control

Volt/Var
Mode 1 –
Normal
Regulation

Simple
Broadcast

Volt/Var
Mode 2 –
Transmission
VAR Support

Utility-Defined Curve Shapes

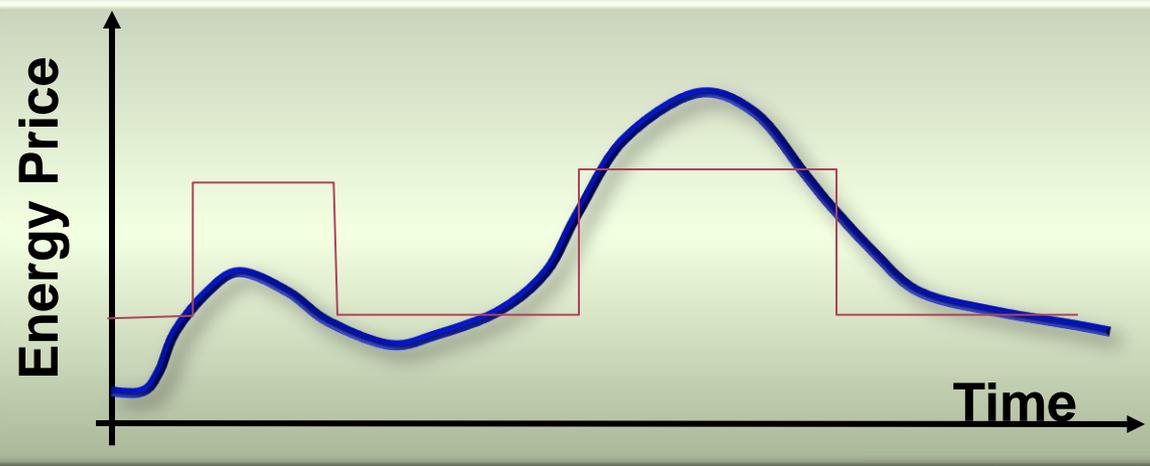
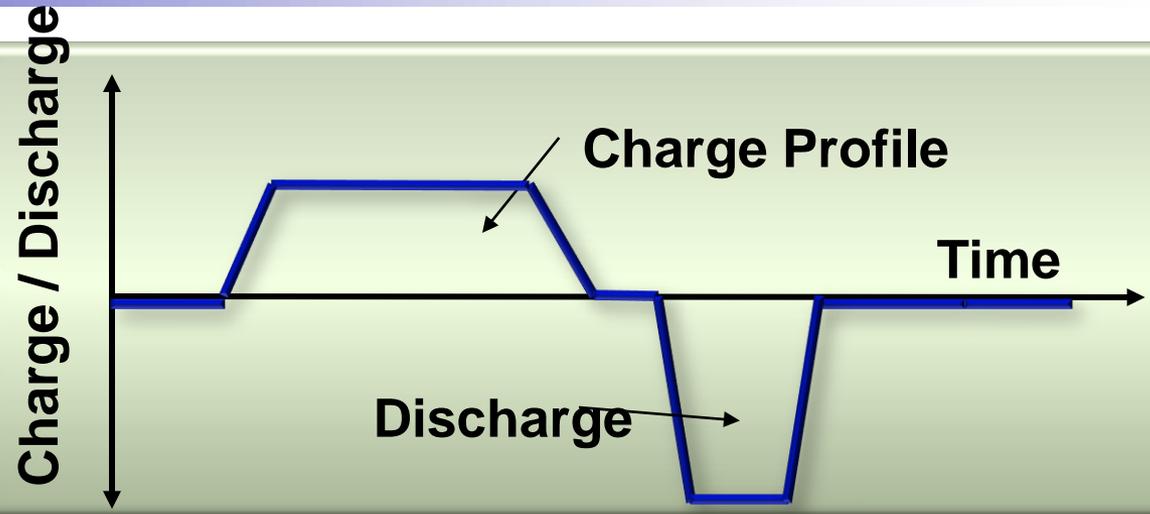


Storage Management

Charge/Discharge Command (%)
Charge/Discharge Schedule

Price Setting
Price Schedule

- Randomization
- Minimum Charge
- Maximum Rate of Charge/Discharge



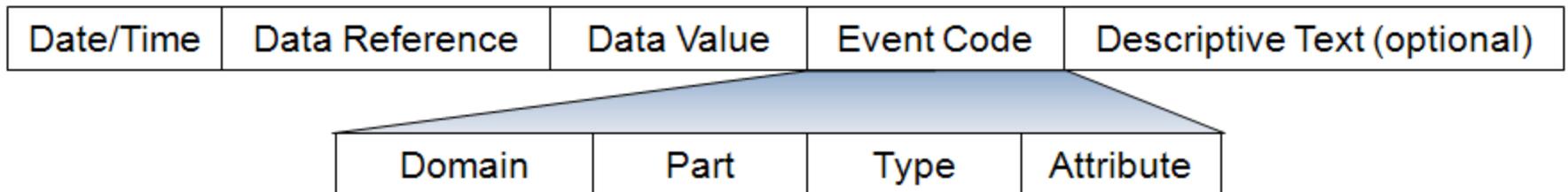
Monitoring & Logging

Monitoring

39 specific status items covered, touching the following areas:

- General Status Information
- Power Measurements
- Battery Storage Status
- Nameplate and Settings

Logging



DNP3 Mapping – What it Could Provide

- Mapping protocol draft completed and being reviewed.
- An inverter provider could design to these documents and be compatible with multiple types of monitoring and management software/systems.
- A DER management software provider could design to these documents and be compatible with multiple types of resources and inverters.
- An interoperability testing or compliance certification facility could evaluate products of all kinds with one another and against the specification.

SEP2 Mapping

- Mapping currently in process. Expected to be available for public review from the SEP people by the end of the year
- The SEP2 protocol is the most prominent for residential HAN integration in the US.
- Coordinated with SunSpec prior to starting the mapping
 - included Phase 1 functions plus extensive status/monitoring points defined by SunSpec

Work Products of Smart Inverter Initiative

