

US/EU Electric Vehicle-Smart Grid Interoperability Centers

APEC-ISGAN Smart Grid Test Bed Network Workshop, January 24-25, 2012

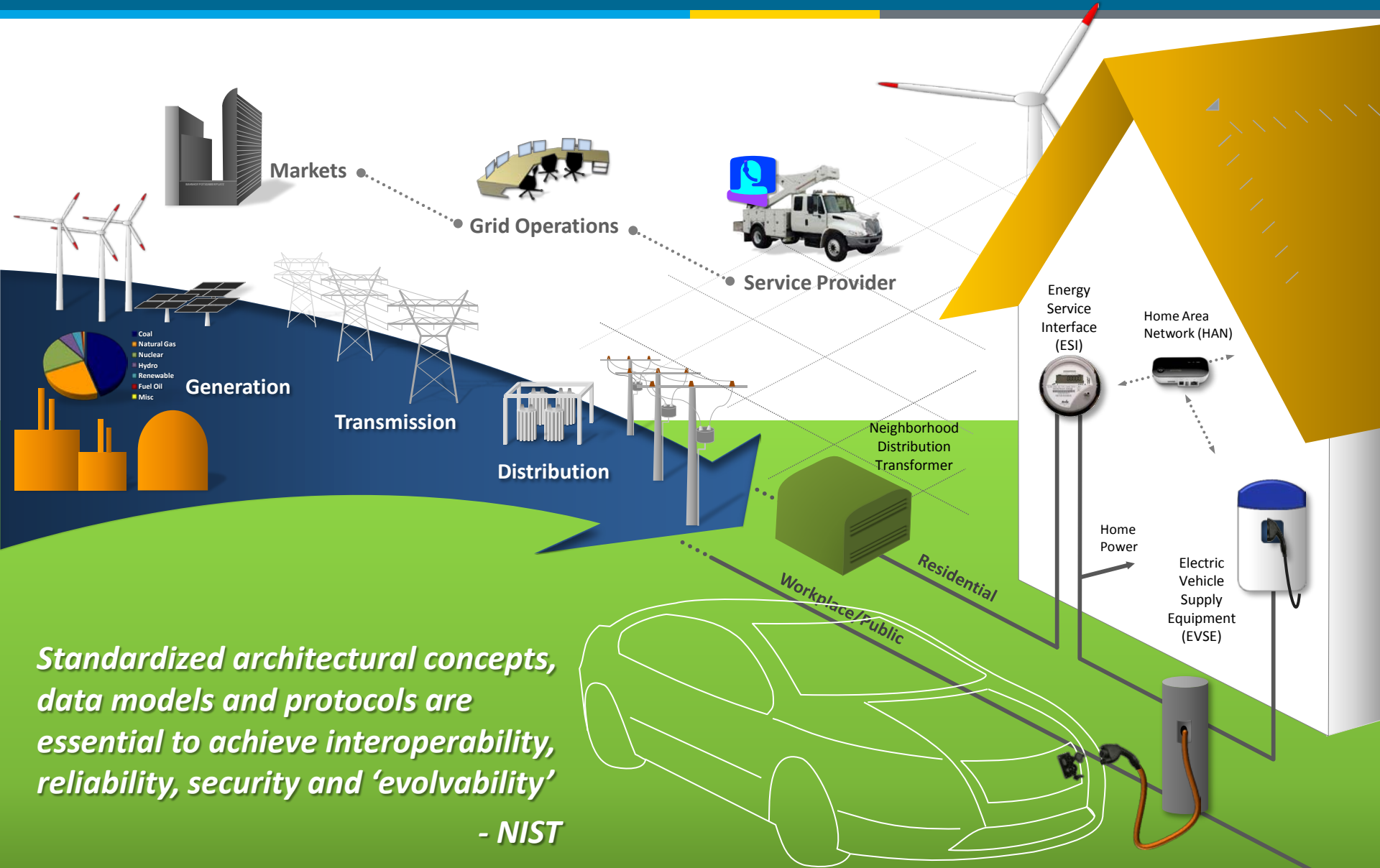
Keith Hardy

Grid Interaction Technical Team
International Cooperation, V-G Connectivity

The Big (Infrastructure) Picture

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



*Standardized architectural concepts,
data models and protocols are
essential to achieve interoperability,
reliability, security and 'evolvability'*

- NIST

EV-grid connectivity and communication

- Development and verification of EV-grid connectivity technology, communication protocols and standards with adequate lead time to support OEM/supplier production schedules

EV-grid interoperability

- Ability to charge any vehicle ... with any charger ... and any service provider ... with a smart grid or not

Regional standards/recommendations

- ACEA recommendations (Europe)
- GB standards (China)

Develop/integrate technology to facilitate smart charging

- Sub-metering
- Communication between the vehicle and charging infrastructure
- Consistent with smart grid implementation standards

Develop test fixtures to support refinement and verification of proposed SAE vehicle-grid connectivity standards

- Communication
- Interoperability
- Wireless charging

Leverage activities to support global cooperation, harmonized standards and component compatibility

- US-EU and US-China cooperative agreements
- Joint activities – pilot projects to facilitate common standards
- Standard laboratory test procedures and protocols

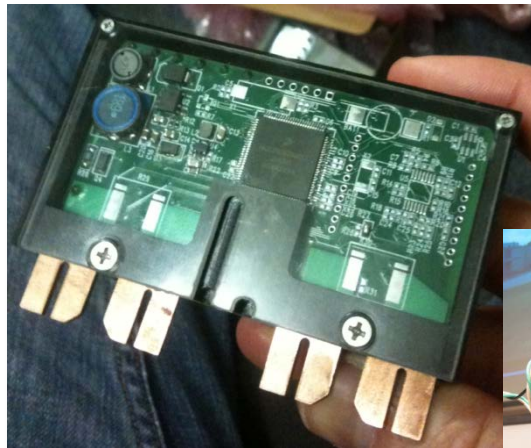
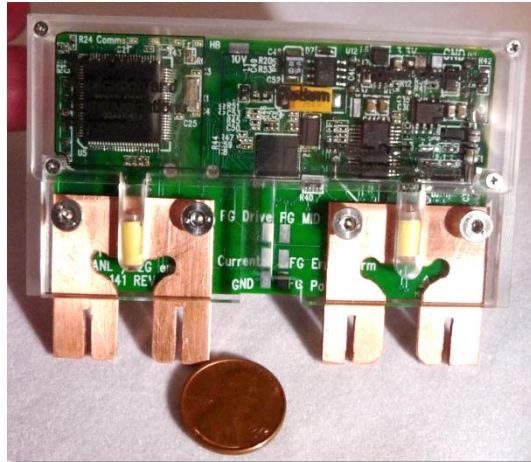


End Use Measurement Device (EUMD)

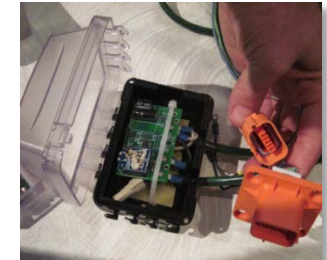
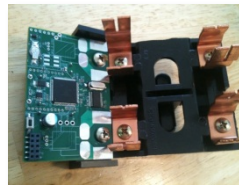
- *EVSE-to-grid messaging*
- Revenue-grade meter communicates EVSE energy use to the energy service provider (via smart meter) or Home Area Network (HAN)

Auto-rem Communication Module

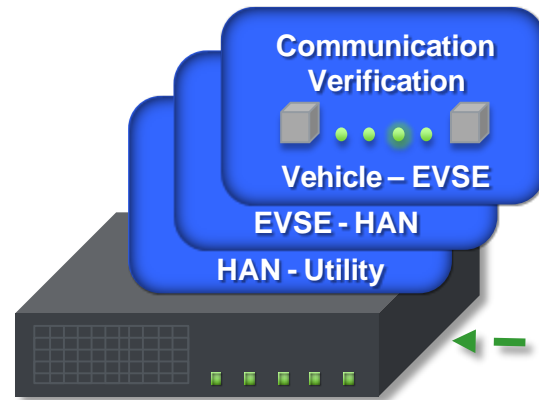
- *Vehicle-to-EVSE messaging*
- Communicates vehicle information to EVSE for identification and charge control
- TI Octave hardware chip set with power line communication (PLC) and CAN interface



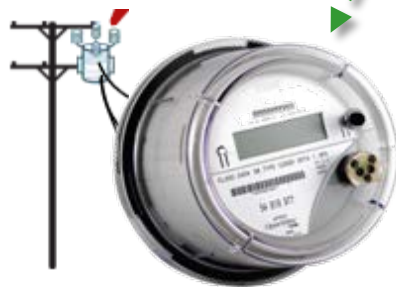
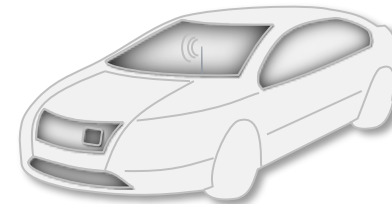
- Designed to ANSI C12 specification
- 0.1% accuracy over full temperature range
- 60A low cost base (~\$5 retail w/enclosure)
- SEP 1.x communication (PLC or Zigbee)
- <\$20 materials, minimal part count
- 8cm x 5cm x 2cm (~3" x 2" x 3/4")
- Fully encapsulated with indicator LEDs
- Modular architecture/socket allows for flexible mounting
 - 1- Transformer monitoring (power, temperature)
 - 2- Fused instrumented disconnect EUMD (w/main meter)
 - 3- Un-fused instrumented disconnect - in EVSE
 - 4- Level 1 EUMD, no electrician, NEMA 5-15, multi-family
 - 5- Vehicle mounted EUMD, plugs into stock charger inlet



Vehicle-Grid Communication Demo



Dell Optiplex quad core PC supervises test fixture, communicates with and exercises each node



Utility Messages

900MHz to back-haul
2.4GHz Zigbee to HAN
(Itron or SilverSpring)



Home Gateway

Digi, Greenwave Reality
HAN- Zigbee/Ethernet

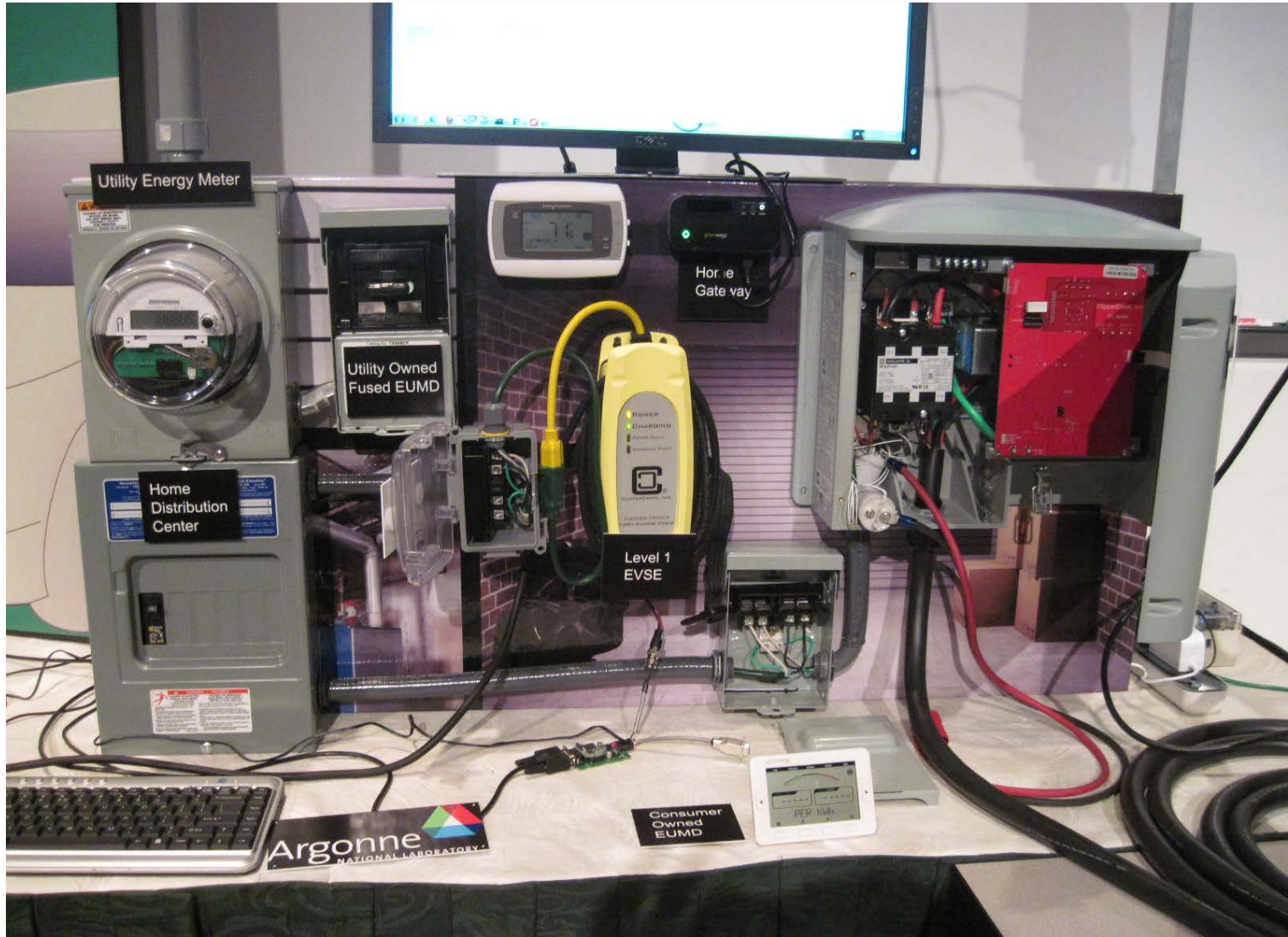


EVSE with EUMD and
Vehicle-EVSE Router;
pass through
HAN-Zigbee/Ethernet



Emulated PEV/Physical EV
Connected to J1772 Emulator,
CAN network, emulated
vehicle data

Vehicle-Grid Communication Fixture



Compatibility/Interoperability

- SAE J2931 (Communication, telematics, security)
- SAE J2953 (EVSE-PEV compatibility)

Power Ratings

- SAE J2907 (Motor and power electronics)
- SAE J2908 (Propulsion system)

Energy Service Provider



Electric Vehicle Supply Equipment (EVSE)

- SAE J2894 (Power Quality for charger – test methods)
- SAE J2954 (Wireless charging)

Support ranges from supplying reference materials to chairing committees, supplying hardware/test fixtures and testing

Charge Coupler

- SAE J1772 (DC)
- SAE J2836 (Use cases for communication)
- SAE J2847 (Communication protocols and messaging)





Photo courtesy of US Department of State

DOE and European Commission Agree on Cooperative Activities to Support Harmonization (November 2011)

- **Agreed to a joint Work Plan for Advancing E-Mobility Cooperation**
- **Established Electric Vehicle/Smart Grid Interoperability Centers**
 - Development and testing of vehicle-grid interface technologies
 - Data-driven standards refinement and common test methods ... to promote more harmonized standards for connectivity, communication and component compatibility
- **Considering Twin Cities Projects**

- Establish Electric Vehicle / Smart Grid Interoperability Centres, at Argonne National Laboratory in the United States and JRC-Ispra, in Italy
- State-of-the-art facilities for development and testing of vehicle-grid interface technologies – encompassing connectivity between electric vehicles, charging equipment, communication networks, electric transmission and distribution grid operators, and energy service providers;
- Active role in standardization; supporting data-driven standards refinement and development, a common approach between EU and US testing of electric vehicle and smart grid equipment, all in an effort to promote cooperative development of and support for global standards;
- Projects to enhance interoperability of electric vehicles, recharging systems and smart grids through, among other things, the development of more harmonized standards for connectivity, communication and component compatibility.
- Inter-laboratory comparisons through ‘round robin’ testing

- Definition/scoping
 - Strategic and operational definition
 - Technical requirements ... based on critical use cases (industry-driven)
 - Facility/equipment specifications and resource requirements
 - Resource, acquisition and fabrication plan
- JRC participation in activities at ANL