The Opportunity for Interoperability of Buildings Equipment and Systems at Scale

Presentation at the May 1 Technical Meeting on Data/Communication Standards and Interoperability of Building Appliances, Equipment, and Systems

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DOE: EERE…

The Office of Energy Efficiency and Renewable Energy's mission is to:

- **Enhance energy efficiency** and productivity;
- **Bring clean, reliable and affordable energy technologies** to the marketplace; and
- **Make a difference in the everyday lives** of Americans by enhancing their energy choices and their quality of life.

EERE spent $16.8 billion in ARRA funds to stimulate jobs and help create a clean-energy economy in the US.

Office of Energy Efficiency and Renewable Energy

Program Priorities	
Biomass	Investing over $1.4 billion to achieve cost competitiveness and commercialization of cellulosic and other advanced biomass feedstocks and biofuels through applied research, next generation pilot scale development, commercial scale biorefinery demonstrations and targeted infrastructure activities.
Buildings	Implementing a systems approach in deploying technologies for "net-zero" energy buildings that produce as much energy as they consume. Builder's Challenge, the Commercial Buildings Initiative, and accelerated building codes and appliance standards implement this new approach.
FEMP	Doubled energy efficiency investment in Federal building through $1 billion of private-party performance contracting. New ESPC contracts will support up $80 billion in energy savings at federal facilities and increase individual contract ceilings to $5 billion over the life of the contract.
Geothermal	Program renaissance emerged on foundation of Enhanced Geothermal Systems (EGS) that allows geothermal energy to be harnessed nationwide providing up to 10% of our Nation's future electricity.
Fuel Cells	Added focus on near-term stationary and early market applications to create economies of scale, accelerate learning-by-doing, and reduce cost of technology for transportation market.
Industrial	Concentrating on the Save Energy Now program, which through energy assessments has resulted in savings of over $100 million and 75 trillion Btus of natural gas.
Solar	Achieve grid parity with PV and other solar technologies by 2015 through advanced R&D over the entire supply chain. Re-invigorate Concentrated Solar Power program through launch of energy storage research and demonstration.
Vehicles	Focusing on fuel flexible Plug-in Hybrid Electric Vehicles through greatly enhanced battery research activities and new utility partnerships.
Weatherization/SEP	Developed stronger ties with States and utilities by providing technical assistance and by developing "best practices" and model policies for faster and larger scale adoption of efficiency and renewable energy.
Wind & Water Power	Assessed feasibility for wind energy to provide 20% of our Nation's electricity which led to new industry vision. Launched new program in wave, tidal and current energy.

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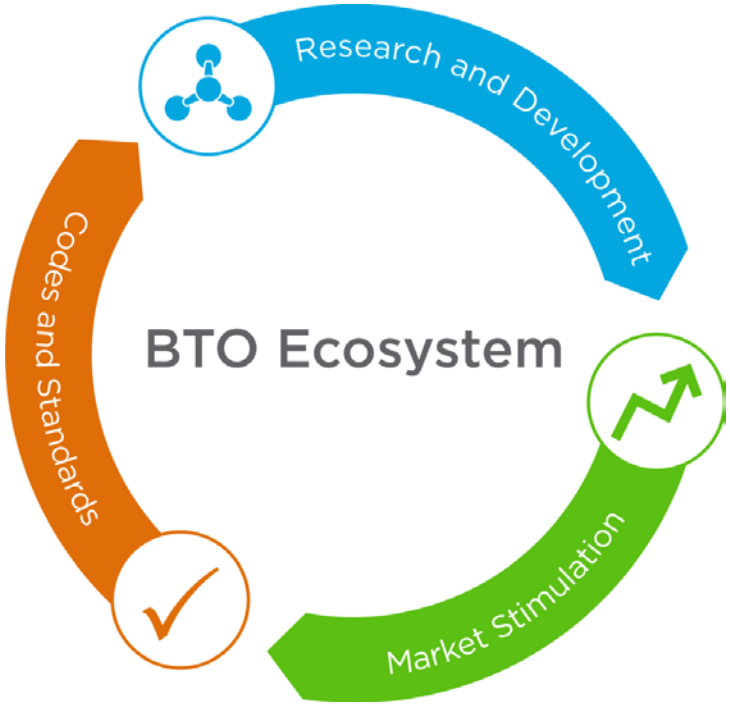
Building Technologies Office (BTO)
Delivering Energy-Efficient Solutions



Emerging Technologies

High-impact building technologies

~Five years to market-ready

Residential Building Integration

Cost-effective technologies, tools, solutions

Peak energy performance in new & existing homes

Commercial Building Integration

Cost-effective technologies, tools, solutions

Peak energy performance in new & existing commercial buildings

Codes & Standards

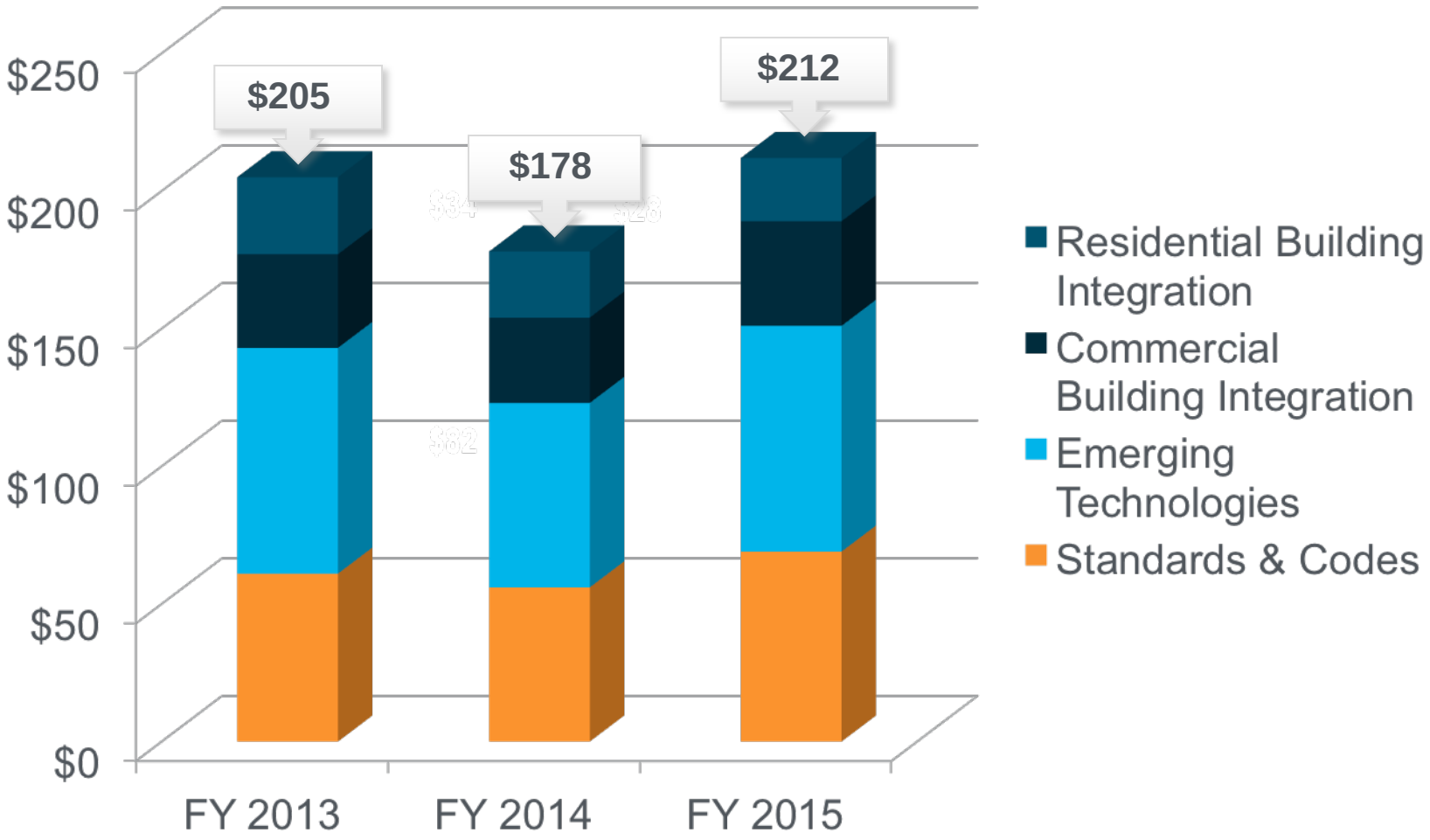
Building energy code language with adoption/compliance strategy

National appliance & equipment standards

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BTO Funding by Program

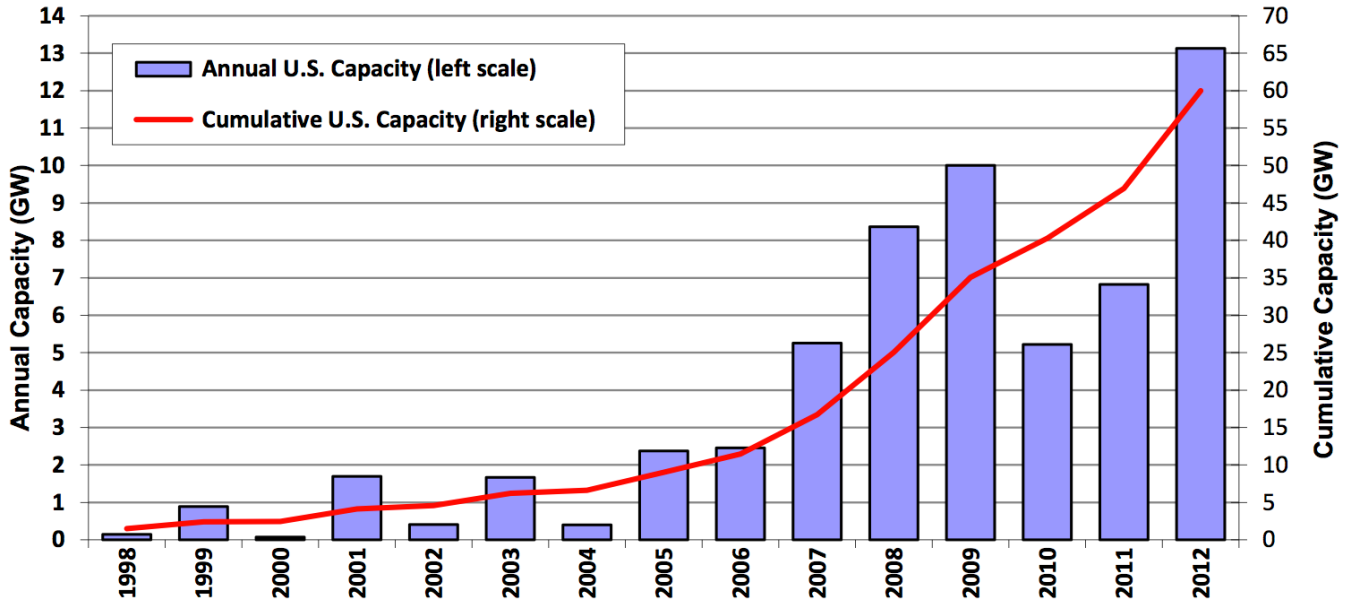
(in millions)



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Grid Integration Initiative

- As EERE **drives down the cost** of emerging technologies, these technologies have started to proliferate into the energy system.
- The Grid Integration Initiative **addresses challenges** associated with the physical operation of the power system when these technologies are deployed at scale.



Source: AWEA project database

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

Seamlessly integrating these technologies into the grid in a safe, reliable, and cost-effective manner is critical to enable deployment at scale.

EERE Grid Integration Activities

- Successful large-scale deployment of EERE's portfolio of clean energy technologies will require the **development of new technologies and techniques** to address grid integration barriers and opportunities associated.

- EERE technologies and solutions includes **improved approaches to technologies and deployments of technologies**. Examples include…

  advanced power electronics (RD), "grid responsive" building technologies (INTEGRATION); vehicle-to-grid technologies (BOTH RD & INTEGRATION), etc.…

- **Close engagement and collaboration** with and among industry and other stakeholders are needed to develop and deploy the necessary standardized communication and control protocols to enable these devices and techniques to successfully interface and interact to enable grid operations while maintaining or improving grid reliability.

How are we going to accomplish these goals…

- **Engage** with utilities, municipalities, and cooperatives for community scale solutions;
- **Develop** and advance common platforms, especially data formats and communication protocols, necessary for a modernized and more flexible distribution system; and
- **Leverage** substantial existing installations of photovoltaic systems, electric vehicles, building energy technologies, storage, and smart grid technologies.
- **Encourage** partnerships between industry, vendors, national laboratories, and other stakeholders;

What we believe in… the Opportunity for Buildings

- **Buildings have a large role** in helping to enhance grid reliability and enabling the rapid integration of Renewable Energy and Storage.

BUT

- **Buildings today are limited** by existing controls systems that can't easily transact at the speed or scale that is required by the grid
  - High cost to "get it right" with existing technology and economics
  - Currently only implemented in large buildings
  - Components are emerging with greater capabilities of control

- **Building solutions must "think across the meter"**
  - Energy Efficiency is at the core, but there are additional value streams to/from third party entrepreneurs
  - Better control of loads have other benefits

- Thinking Differently will unlock new value streams…

What would success look like in the building domain?

"Across the meter solution to enable transactions for commoditizing energy related services"

Every building device (whether generating or using electricity) should know **how it is performing, how it could perform, and be capable of communicating** that to the internal/external systems and the grid to unlock financial motivation for all participants.

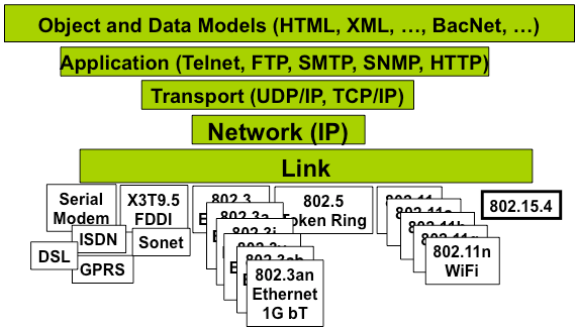
- Add in technology with "smarts"/intelligence to protect owner/operator from negative consequences
- Must "know" actual and potential operational characteristics
- Must be able to match or settle transactions and "report back" to all parties

Scale is achievable with Energy Efficient and Network-Ready Device

ILLUSTRATIVE

Energy efficient and smart equipment may have the following characteristics:

- Are energy efficient products (as covered by energy conservation standards).
- Have the capability to communicate with the grid or a building system in an interoperable manner.

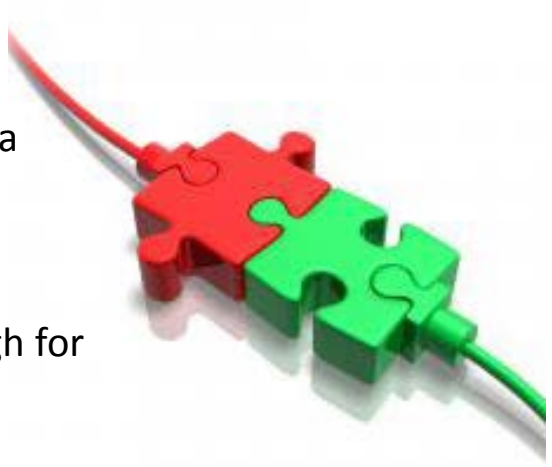


- Have a standard, open protocol for communicating data/signals to and from the grid and/or the building system
- Have sensing and control capability to decrease or increase load in reaction to that data

- Allow for provision for simple configuration and implementation of consumer's desired degree of flexibility in use of their appliances and equipment with respect to participating or acting upon system signals
- Able to respond to data/signals do not negatively impact device life-time.

What is needed for this Scalability?

All of this is possible today, so what is the problem?



Interoperability – equipment, systems, EVs, PV and buildings do not have a common data taxonomy or communications protocols.

- Many companies make products that are either "smart" or enable some kind of transaction**, most use their own proprietary protocols**.
- Many quasi standards are in place, but they are either not specific enough for complete interoperability or only cover a limited number of situations.

Therefore, every interconnection requires a patchwork of different systems

Cost – because each piece of equipment needs additional work to interoperate, there is added cost to the end user and to manufacturers

- An open communication protocol, that can transact with proprietary systems and is specific enough to enable these transactions, will lower costs and increase applicability.
- Common data taxonomy (formats, etc..) will ensure that information is understood and used efficiently.

Loads, energy storage, and distributed generation will be part of a dynamic future grid, lowering the future costs for reliable power, with clear value propositions for all participants.

Largest unresolved issue is agreement for integrated, interoperability of equipment

- An enormous amount of physical information is available today as the cost of communication and instrumentation has fallen, yet that **data is trapped**.
  - information from and about equipment, equipment states, energy usage, potential reductions, etc.. --
- However, making use of that information is still challenging.
  - The information is frequently silo-ed into proprietary systems,
  - The information is frequently available only in batch, and
  - The information is fragmentary and disorganized.
- **The lack of this information about the equipment causes the asset to be stranded**
  - It cannot be pooled to the greater benefit of the system, and
  - It can run away, act sporadic, or exist randomly.

Vision & Objectives for DOE Involvement

- VISION:
  - For Grid Solutions, DOE will provide clear and consistent definition for energy efficient and smart/utility-ready appliances, their characteristics/capabilities, and their potential value to consumers, utilities, and manufacturers.

- Objectives:
  - Work with manufacturers through an open/transparent process to **develop physical characterization procedures**, leveraging existing efficiency testing protocols to the extent practical.
  - Work with testing labs to develop the capability to **conduct tests**, leveraging the existing testing infrastructure to the extent practical.
  - Work with market participants and stakeholders to define and **communicate the value of "smartness**," leveraging existing DOE/EERE and DOE/OE programs.
  - Work with utilities to encourage appropriate **deployment** of energy efficient and networked appliances and equipment, leveraging existing utility efficiency programs after the benefits and values are clear.

Planned Technical Meetings

Engaging manufacturers, utilities, and other stakeholders is critically important to the success of this effort.

•DOE will be developing these procedures and methods in an open and transparent process with public meetings and commenting periods.

DOE is planning a series of technical meetings to collect feedback and provide input on the process…

- Phase 1: verify understanding of current state, refine value proposition, solicit input for metrics development, review equipment prioritization for testing schedule.
- Phase 2: solicit comments on draft metrics and characterization procedures.
- Phase 3: roll out characterization procedures and initial results from equipment tests.

EERE BTO's BTG Website

EERE >>> Building Technologies Program >>> Emerging Technologies

http://www1.eere.energy.gov/buildings/technologies/buildings_grid_integration.html