BUILDING DEMAND RESPONSE AND THE COMING SMART GRID

Dr. Tom Lawrence, PE, LEED-AP
lawrence@engr.uga.edu

ASHRAE

The University of Georgia
College of Engineering

Introductions and Topics Covered

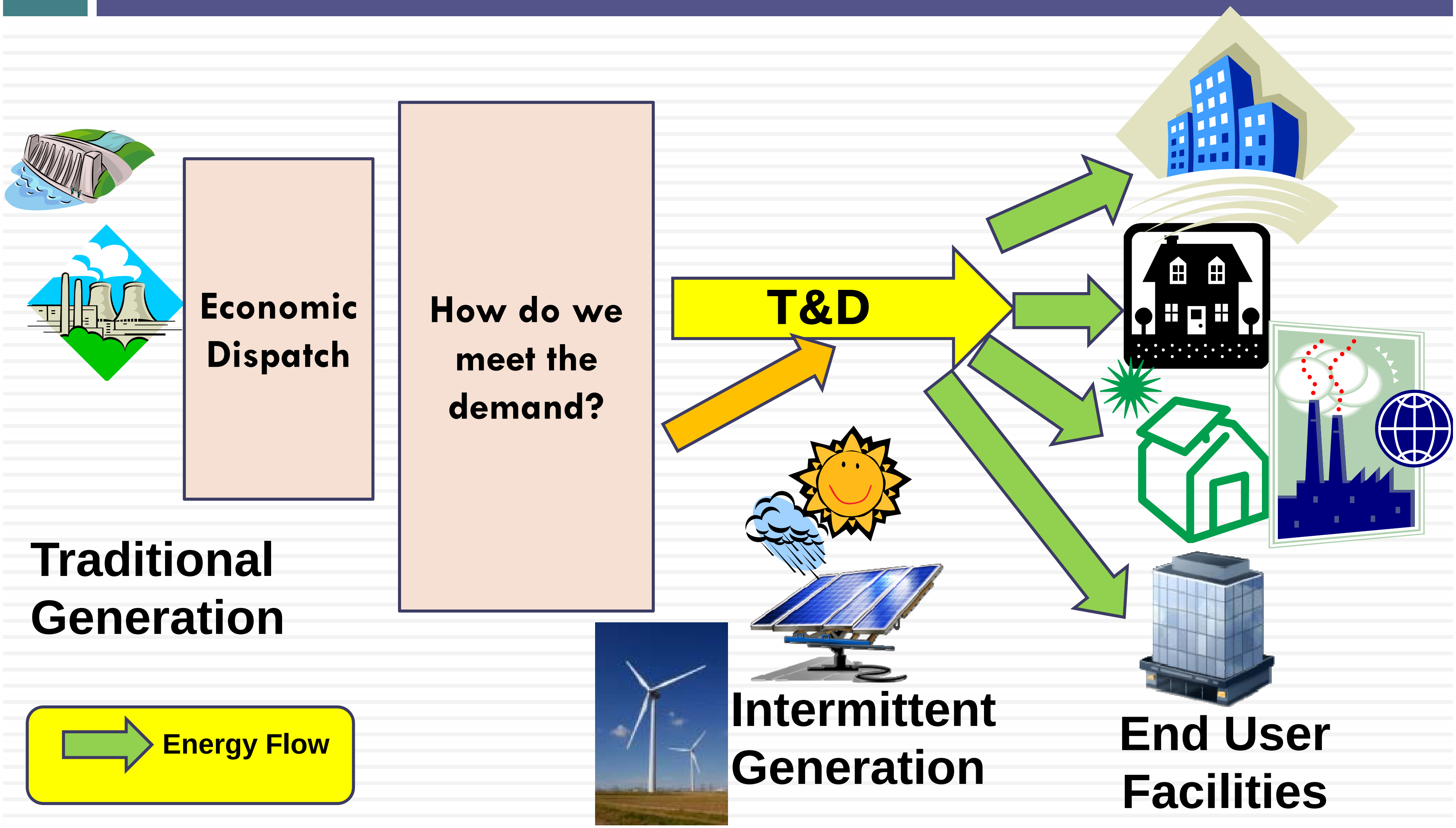
- What is the smart grid?
- Demand Response Management
- Buildings interaction with a smart grid and demand response signals
- The vision for the future

Smart Grid Definition

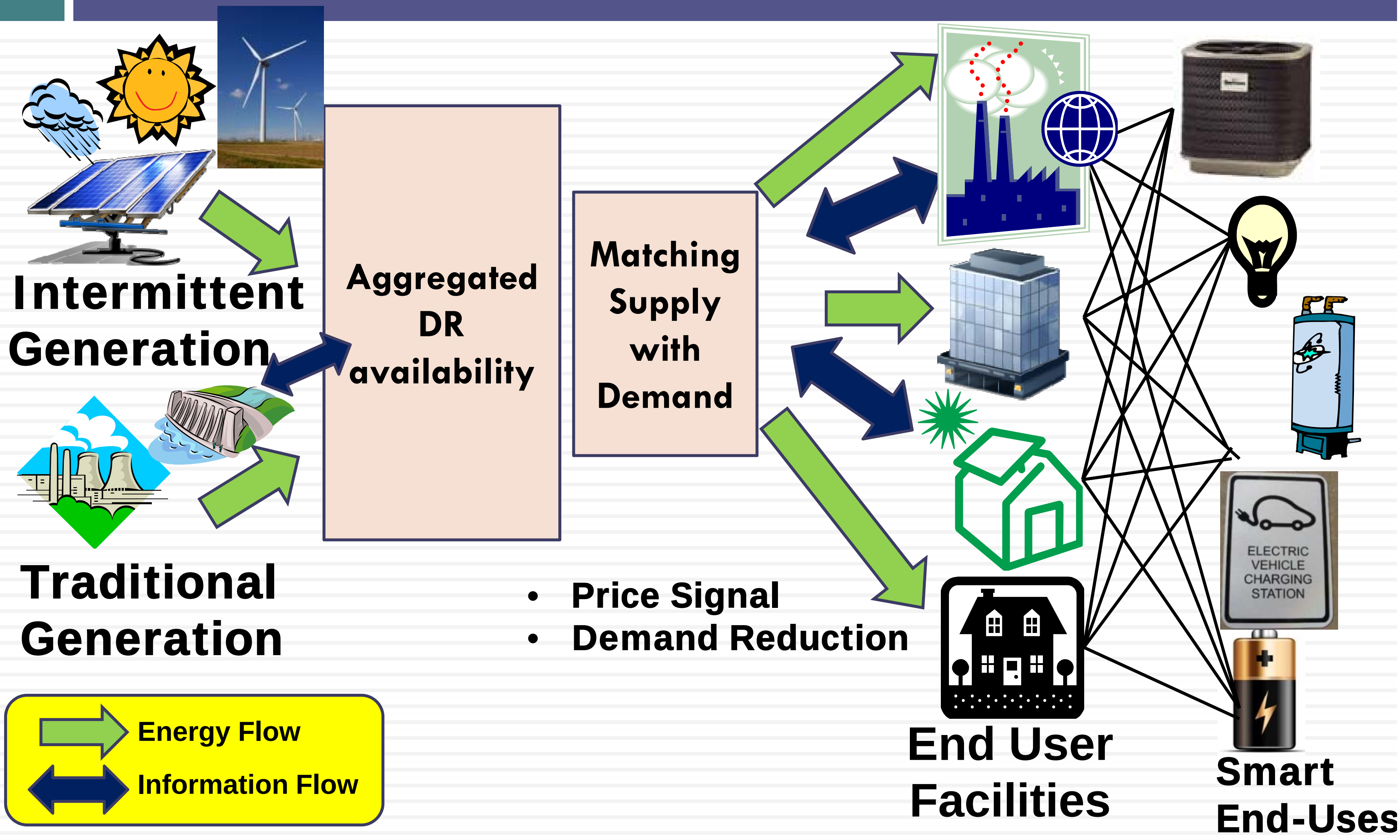
What is the "Smart Grid"?

- Modernized electrical grid using information and technology to more efficiently produce, transmit and use electricity
- Each sector of the electricity supply chain has different goals and objectives for the smart grid
- The "rules of the game" are changing in how utilities and the end users (customers) interact.

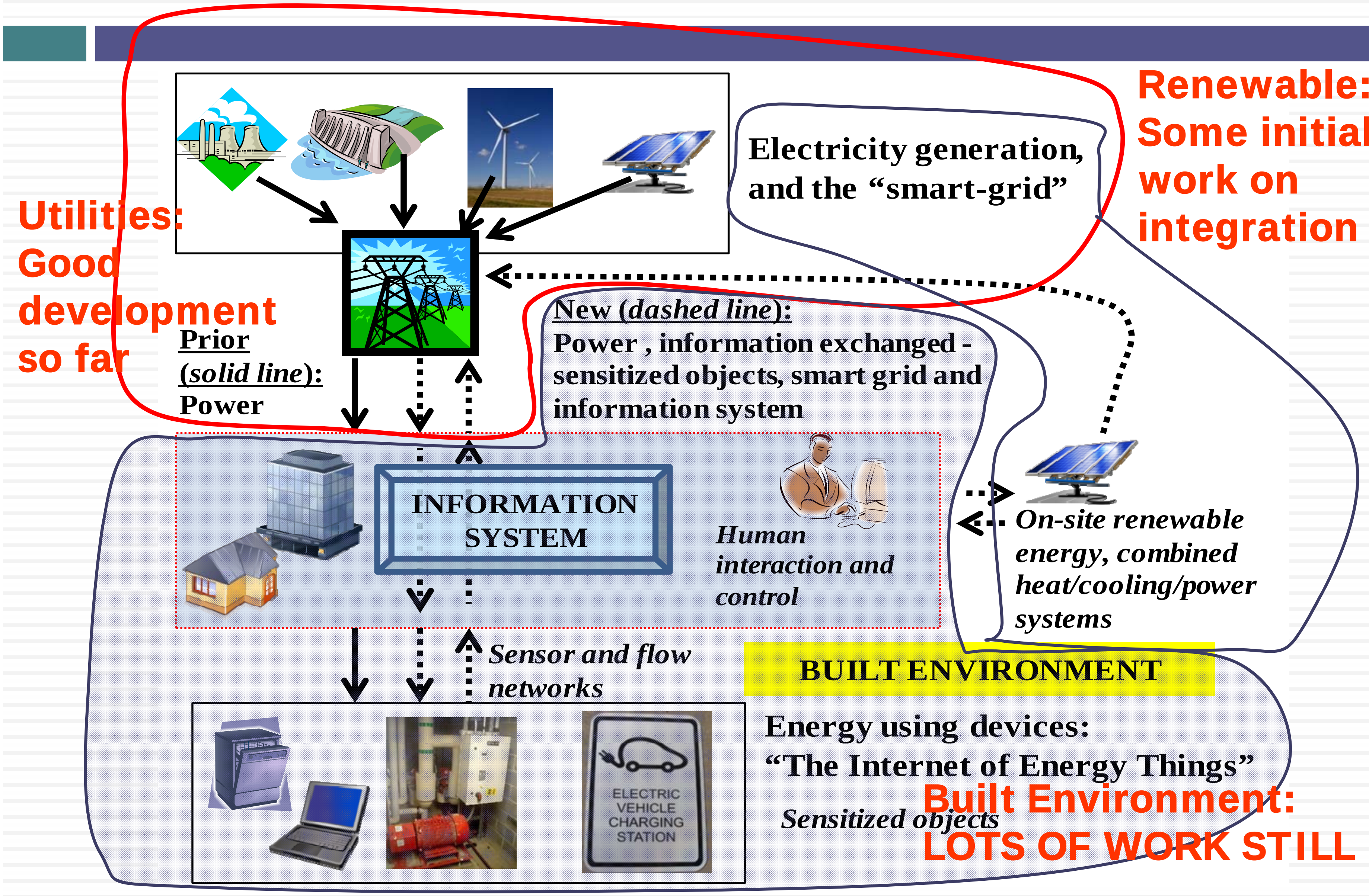
How Grid Interaction is Done Today (without Demand Response)



Grid Integration of the Future



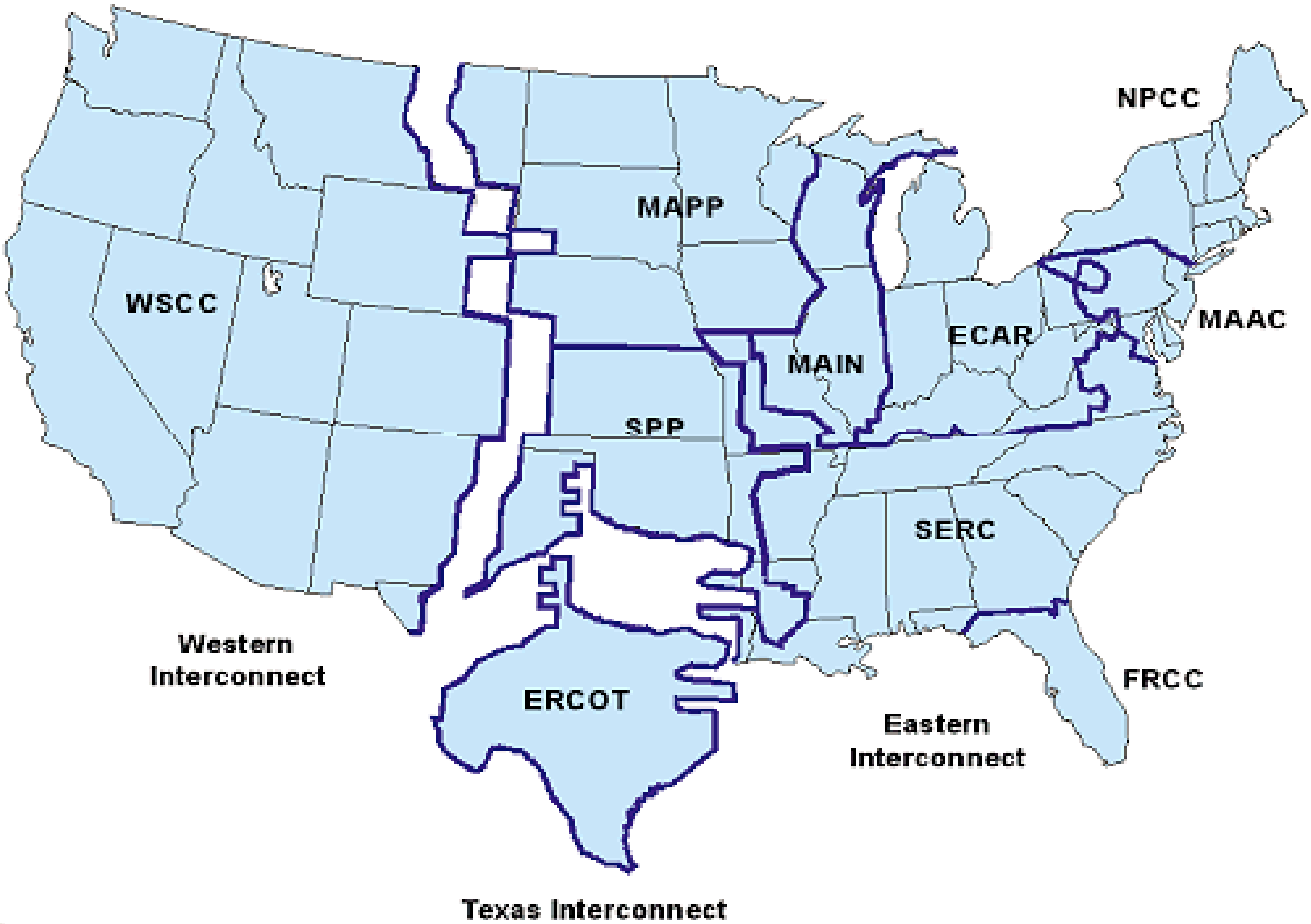
The Grand Challenge

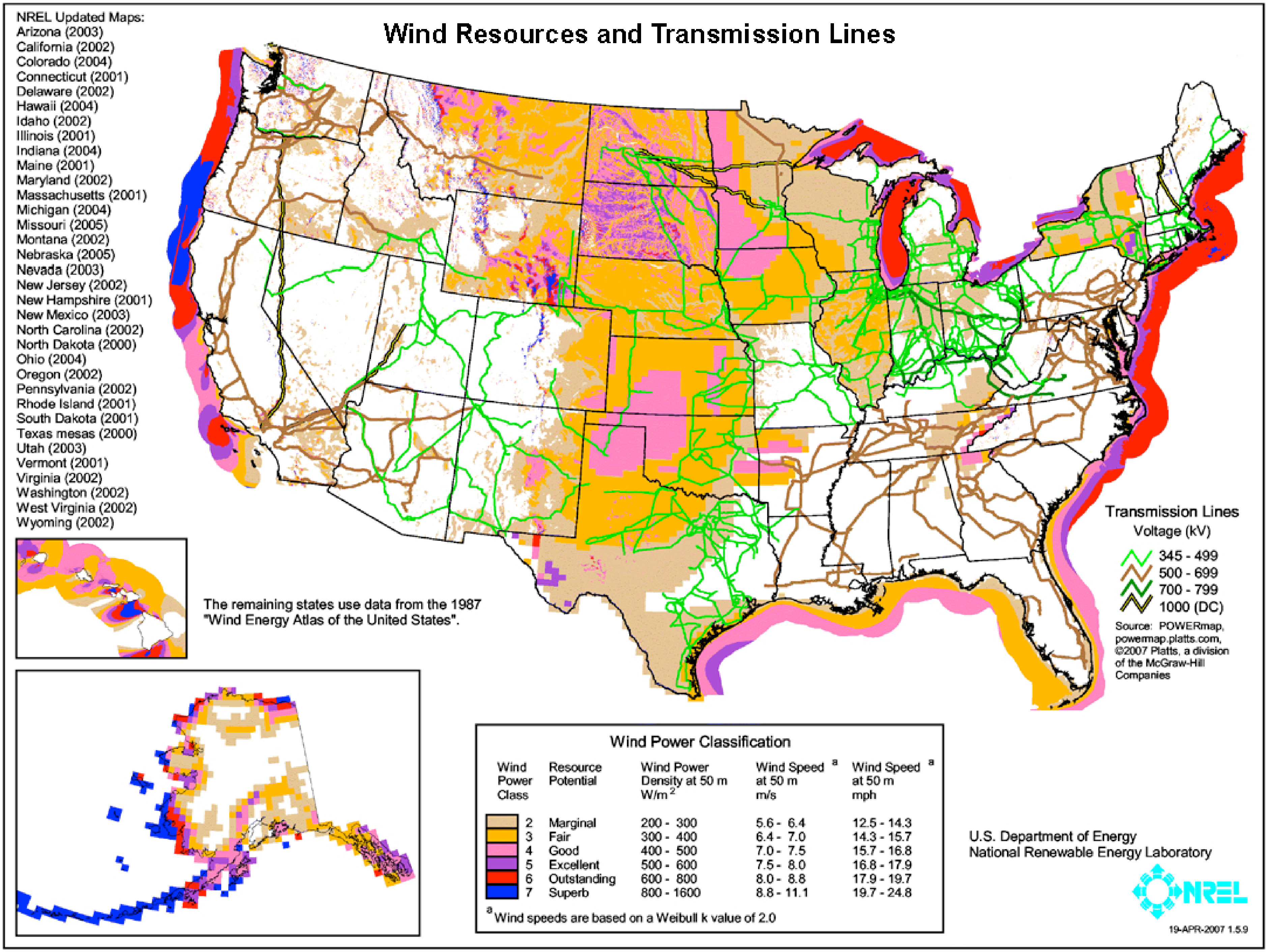


Benefits of a "Smart Grid"

- **Utilities**
  - Manage peak demand events
  - More efficiently predict and control demand and integrate with supply availability
  - Reliability improvements
- **Users** : Primarily a cost minimization or cost management tool
- **Utilities and Users:** More disaggregated data streams on energy consumption (time as well as where electricity is being consumed)
- **Society**: Will help smooth integration of renewable energy into the grid

The U.S. Electric Grid





Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

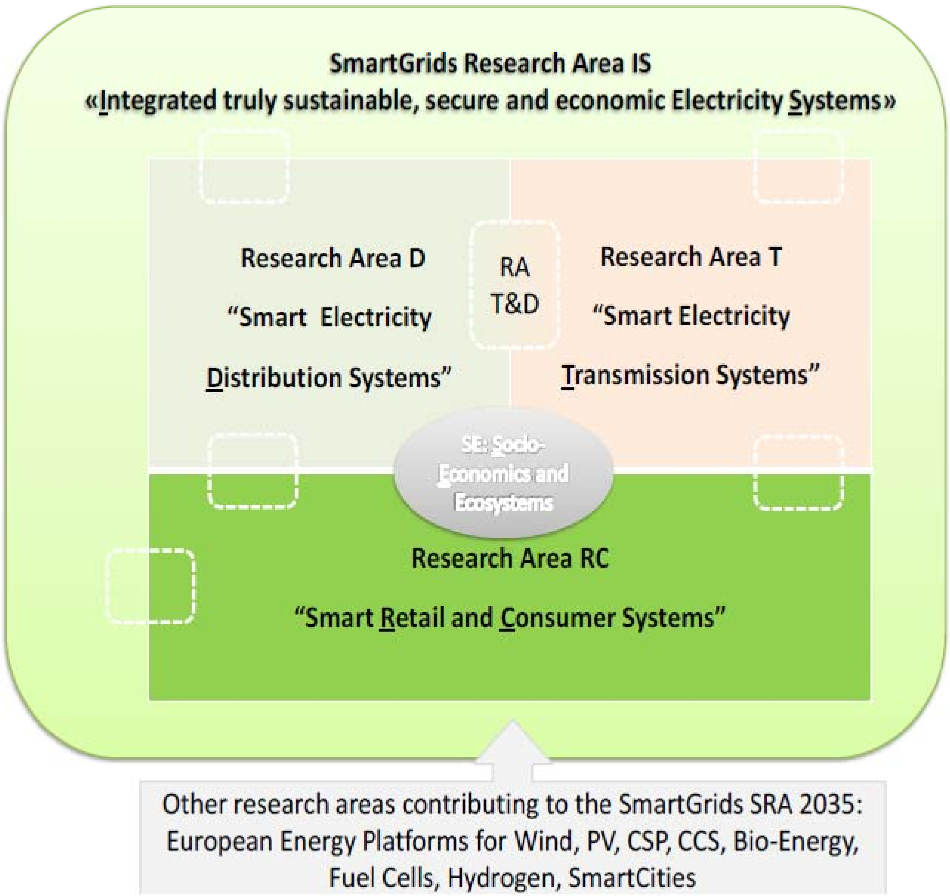
[a] Wind speeds are based on a Weibull k value of 2.0

Smart Grid in Europe

- European Technology Platform for Electricity Networks of the Future (ETP SmartGrids)
  - Forum for integrating policy and technology research initiatives

http://www.smartgrids.eu/

European Research Agenda for Smart Grid Not Really Focusing on Buildings



Smart Grid in UK

- Installation of meters …
- Separation of energy retailers and those that generate / distribute electricity makes it harder for full grid and smart metering operation
- The <u>potential</u> is there for efficiency in the system

Smart Grid Components (Now or Potential for Future)

- Smart meters
- Two-way communication between utility and users (devices/buildings/industrial/transportation)
- Grid management logic and software
- Demand management logic and software
- Information flow, technology
- Load management through energy storage, use scheduling

A Big First Step: Smart Meter Installations

- Example:
  One major electric utility in U.S. recently completed a conversion of 100% of its meters to “smart meters” [4.6 million units]

  This was justified within the company however simply through the cost savings for meter reading, limited application of the ‘power’ that this gives to moving toward a smart grid.

Why should I care?

- As an ASHRAE or CIBSE or related similar society member, this is important because…
  - The "smart grid" (in some form) is coming regardless
  - Buildings (commercial and residential), as well as industrial, will be affected in the future
  - Building systems such as HVAC and lighting will be most involved with communicating energy use and adjusting demand based on the grid requirements
  - Potentially opening up a new discipline specialty beyond just "energy efficiency" to "load management"
  - Equipment and software suppliers are already converted their products

Demand Response and Management

Electric Peak Demand Management

- Peak demand management and response are becoming more important in building systems and control
- May not have much impact on the individual building total energy use, but important for overall societal energy and environmental management
- **Considerations beyond just that one building's energy cost and utilization**
- **Demand Response has been defined as the "killer app" for the Smart Grid**

Demand Response Scenarios

- **A. High Demand Relative to Supply:**
  - Reduce peak demand during high load conditions or grid "stress"
  - Typically a summer cooling issue (occasionally in winter heating in some locations)
- **B. High or Variable Supply Relative to Demand:**
  - How to manage peak production from distributed generation systems (renewable, CHP)?
  - Germany in June 2013
  - Becoming more common in parts of U.S. (at night, wind)
- **C. Managing for Low Carbon Energy Production:**
  - An issue particularly for UK and EU now, others in future?
  - Management of demand to match type of supply available

Different Parties Benefit Different Ways

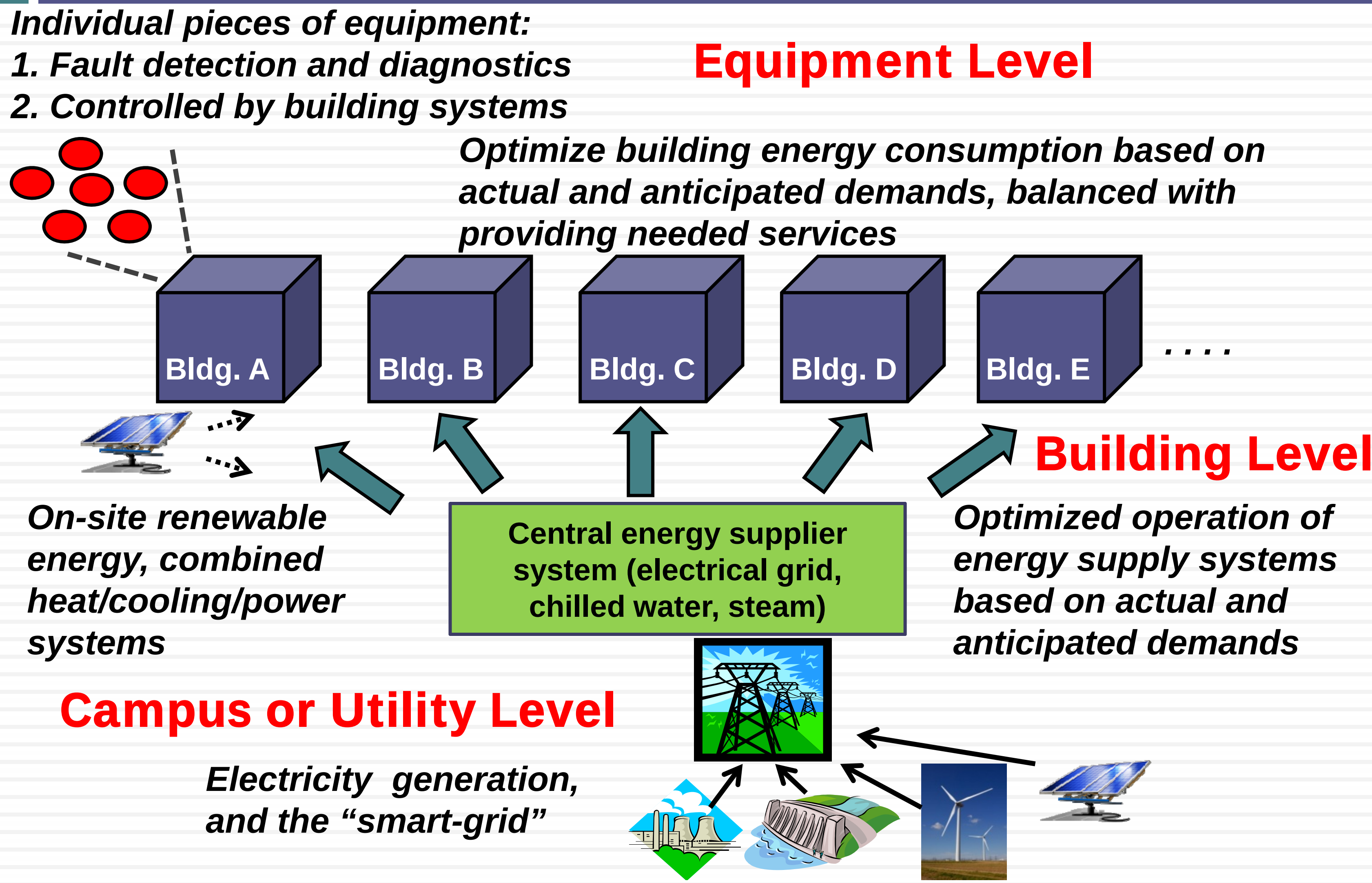
- Demand Response scenarios A and B have led to market pricing problems for electricity on a regional basis – **A problem for utilities needing solutions**
- Volatility in electricity pricing market a potential opportunity for building energy managers/owners

Buildings Interaction with Smart Grid

Buildings Interaction with the Grid

- Used to be a "one-way street"
- Now buildings can receive and send electricity
- A two-way street also exists for information
  - Utility communicates information on grid operation and operational needs (such as demand response request)
  - Buildings can (or will be able soon to) send operational status of building systems
  - The "Internet of Energy Things"

Building Electricity Demand Response and the Smart Grid



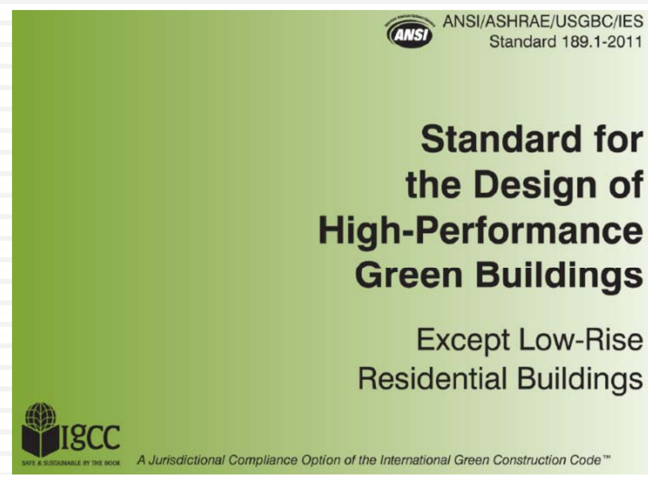
LEED v4 EA Cr 4: Demand Response (DR)

- Case 1: DR Program Available (2 pts)
  - Participate in the program through contract
  - Design system with capability for automate DR (Semi-automated allowed in practice)
  - Include DR in the commissioning
- Case 2: DR Program NOT Available (1 pt)
  - Provide infrastructure to take advantage of a future DR program, including meters and developing a comprehensive plan for load shedding of at least 10%

Demand Response - Becoming "Code"

- ASHRAE Standard 189.1 includes a limitation on building peak electrical demand:
  - **Reduce peak demand of the building through active controls or other load-shifting measures (by 10%)**
  - **Standby generation does not count**

<u>For the High-Performance Building Designer:</u>
Investigate new technologies for load-shifting, energy management based on utility pricing or other 'signals'



International Green Construction Code (IgCC)

When required by the local building code authority:

- Automated demand response infrastructure via building energy management system
- *Exceptions for locations without utility demand response programs; buildings with peak electrical demand < 75% of reference; or buildings that generate 20% or more of energy demand by onsite renewable energy*

- Reducing demand in HVAC systems by 10%
- Capable of reducing lighting in Group B office spaces by not less than 15%.

IgCC Demand Response

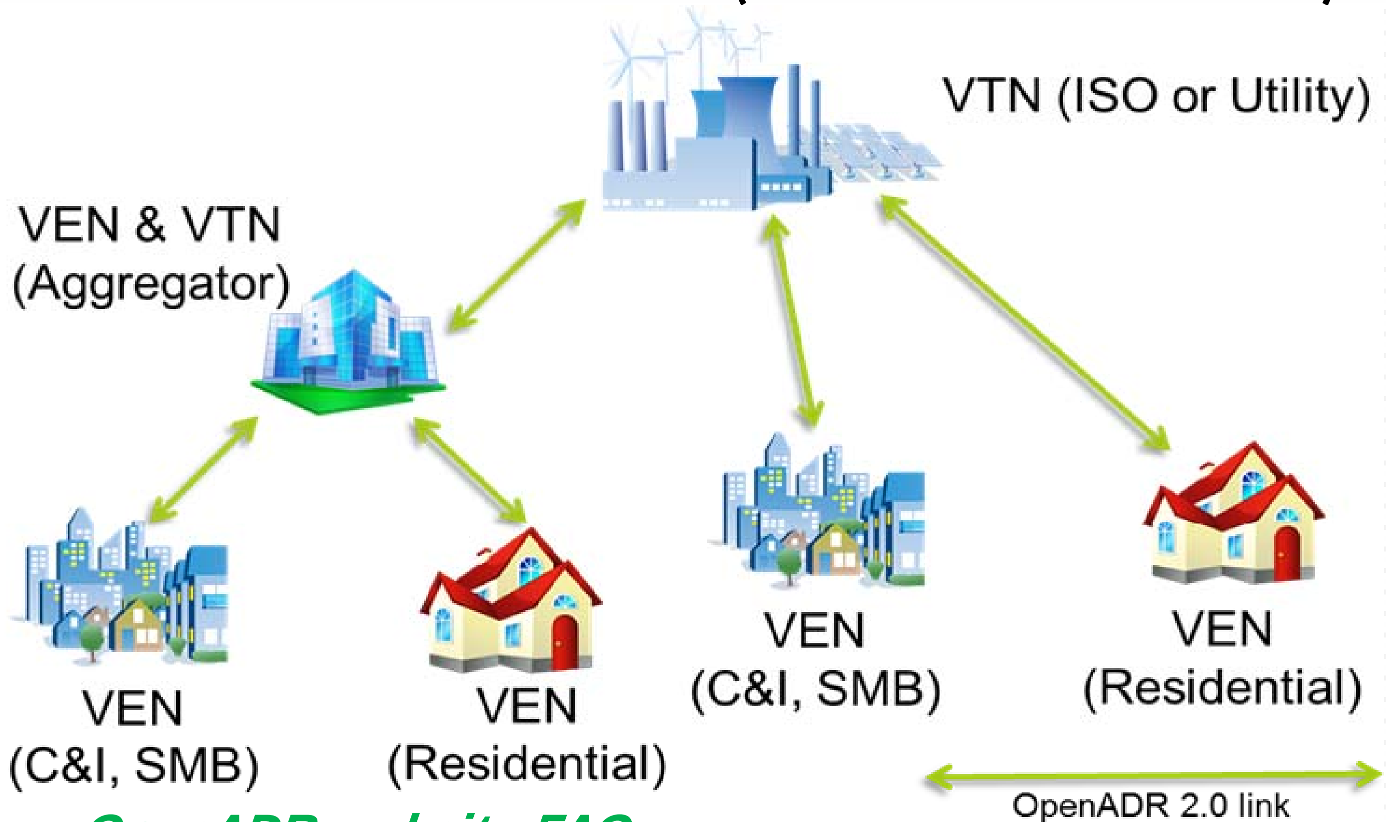
- Achieve 10% HVAC reduction through combination of:
  - Space temperature resets or disabling in unoccupied areas
  - Chilled or hot water supply temperature resets
  - Equipment cycling
  - Limiting capacity of supply fans, pumps
  - Anticipatory control strategies (precool, preheat)
- Include control logic to include“rebound avoidance”

Need a Standard Method for Communication

- OpenADR (Open Automated Demand Response) system concept developed out of initial field testing of automating demand response.
  - A standard way of communication between the electric utility provider or ISO and the building's control systems for implementing demand response measures
- OpenADR 1.0 donated to OASIS (Org. for Advancement of Structured Information Standards) Energy Interoperation Technical Committee in 2009 to help promote the use in U.S. and internationally
- OpenADR 2.0 protocol (Open Automated Demand Response) in U.S. and intended for international adoption
  - Developed and managed by the OpenADR Alliance (industry, member sponsored non-profit)

OpenADR Communication Architecture

- VTN = Virtual Top Node (server sending signals)
  VEN = Virtual End Node (end user or device)



Source: OpenADR website FAQ

OpenADR 2.0 Levels

The OpenADR 2.0 profile specification is divided into three parts:

- **Profile A:** Is designed for resource-constrained, low-end embedded devices that can support basic DR services and markets. Profile A is well suited to support standard DR programs.
- **Profile B**: Is designed for high-end embedded devices that can support most DR services and markets. Profile B includes a flexible reporting (feedback) mechanism for past, current and future data reports.
- **Profile C**: Sophisticated controls and high-end computer systems like servers to support all services and markets.

From OpenADR website FAQ

Where OpenADR has been employed

- Besides the U.S. OpenADR employments are undergoing in places as diverse as Europe, India, Japan, South Korea, Australia and China.

Proposed ASHRAE Standard 201

BSR/ASHRAE/NEMA Standard 201P

Advisory Public Review Draft

Facility Smart Grid Information Model

Standard 201P Status

- Advisory public review during 2012;
  72 comments identified and being incorporated
- Internally working on preparation of a formal public review for publication in January 2014

Future Issues

Topics that will Become Important for Future Smart Grid, Smart Building

- Need for ability to predict supply and demand better, information flow modeling
- A future "Consumption Rights Market"?
- Utilities evolving to more of purveyors of electrons with growing advent of distributed generation (CHP and PV systems)
- Building systems designer, equipment providers need to grasp this coming concept and develop new methods / technologies

Thank you!

- Comments, questions, concerns, advice …

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