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Energy Efficiency/Smart Infrastructure Public Advisory Group

Why Are We Here?

GridWeek
April 23, 2007

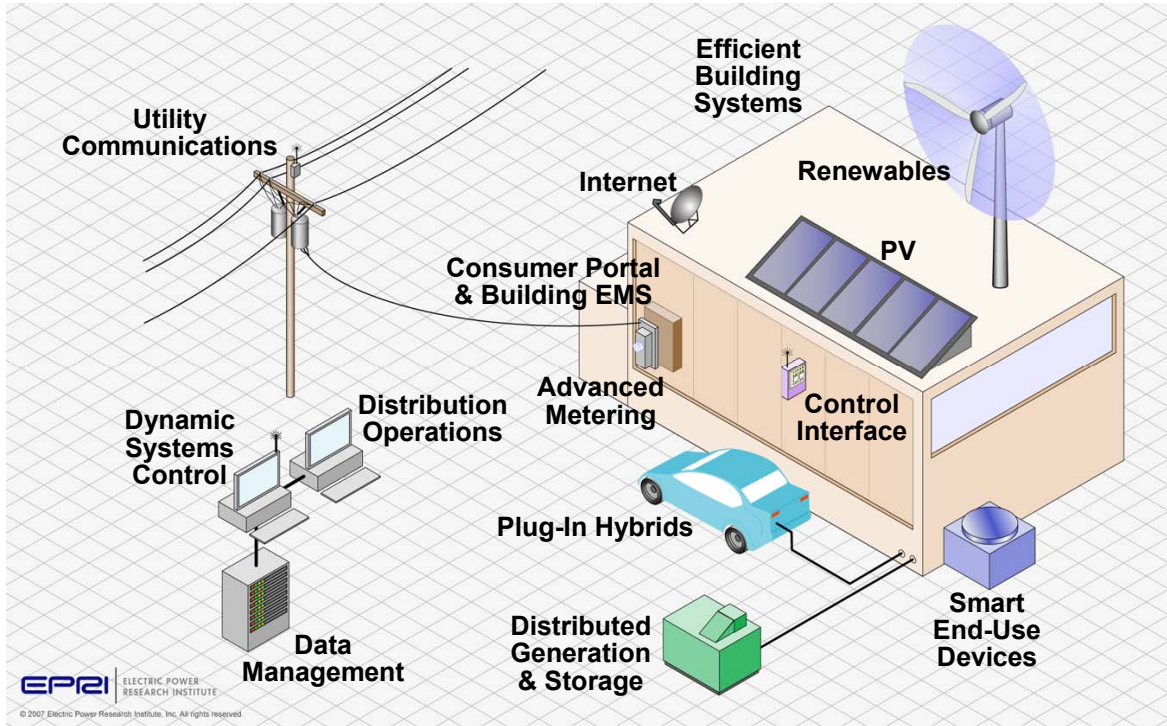
Ellen Petrill
Director, Public/Private Partnerships

EPRI Overview

- Non-profit center for public interest energy and environmental research
- $300M annual budget
- Collaborative model leverages resources
- Advisory structure assures linkages with leaders and users
- Comprehensive portfolio covers over 100 program areas
- Independence assures objectivity

Energy Efficiency and Smart Infrastructure Initiatives

- Need broad input and support for a common vision
- Take “cathedral thinking” to accomplish
- Require widespread acceptance to achieve goals



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Public Advisory Group Purpose

Build awareness and more robust solutions with diverse and critical stakeholders

- Provide advice and support
  - To assure research is conducted in the public interest
  - To increase awareness of research and results
  - To improve likelihood of implementation
- Coordinate with other activities
  - To avoid duplication
  - To build robust solutions

Goal: Win-win outcomes for utilities and society

Diverse Stakeholders Leverage Resources

Examples of Engagement with IntelliGrid Public Advisory Group

- Michigan
  - Smart grid recommended in Michigan's 21st Century Energy Plan
- Texas
  - Regulator initiated smart grid discussions with utilities
- Outreach
  - Public presentation
  - Presentations in conferences
  - Newsletters

Today

- Meeting Objectives
  - Initiate discussions
  - Plan how this group operates
- Review research plans
- Roundtable
- GridWeek
  - Smart grid messaging
  - Roadmap
  - Plenary session
  - Reception

Roundtable Discussion

- Comments on the research plans
- How can the public sector help achieve the intelligent grid?
- What can you do to help achieve widespread adoption of dynamic energy management?
  - Pricing
  - Utility costs, revenues, and profits
  - Support R&D
- What can EPRI do to assist market transformation?
- What more information/help do you need from us?
- Comments on how this group will work

Together…Shaping the Future of Electricity

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Energy Efficiency Initiative Research Plan

April 23 2007

Tom Reddoch
Manager Energy Utilization
Power Delivery & Markets

Do We have a Plan for this World?

Topics for Today's Presentation

- Why energy efficiency now
- How critical is the research
- What is our strategy
- What are key deliverables now and beyond
- Your advice

Why an Energy Efficiency Initiative now?

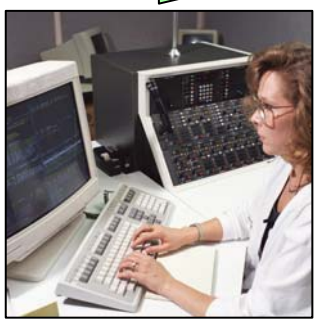
Increasing

Electricity prices

Shortage of new capacity

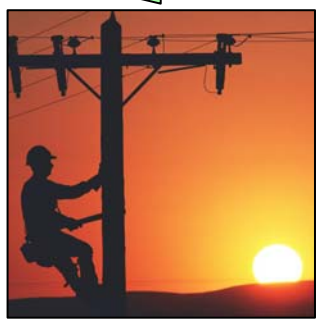
Vulnerability to foreign imports

Awareness to climate and the environment



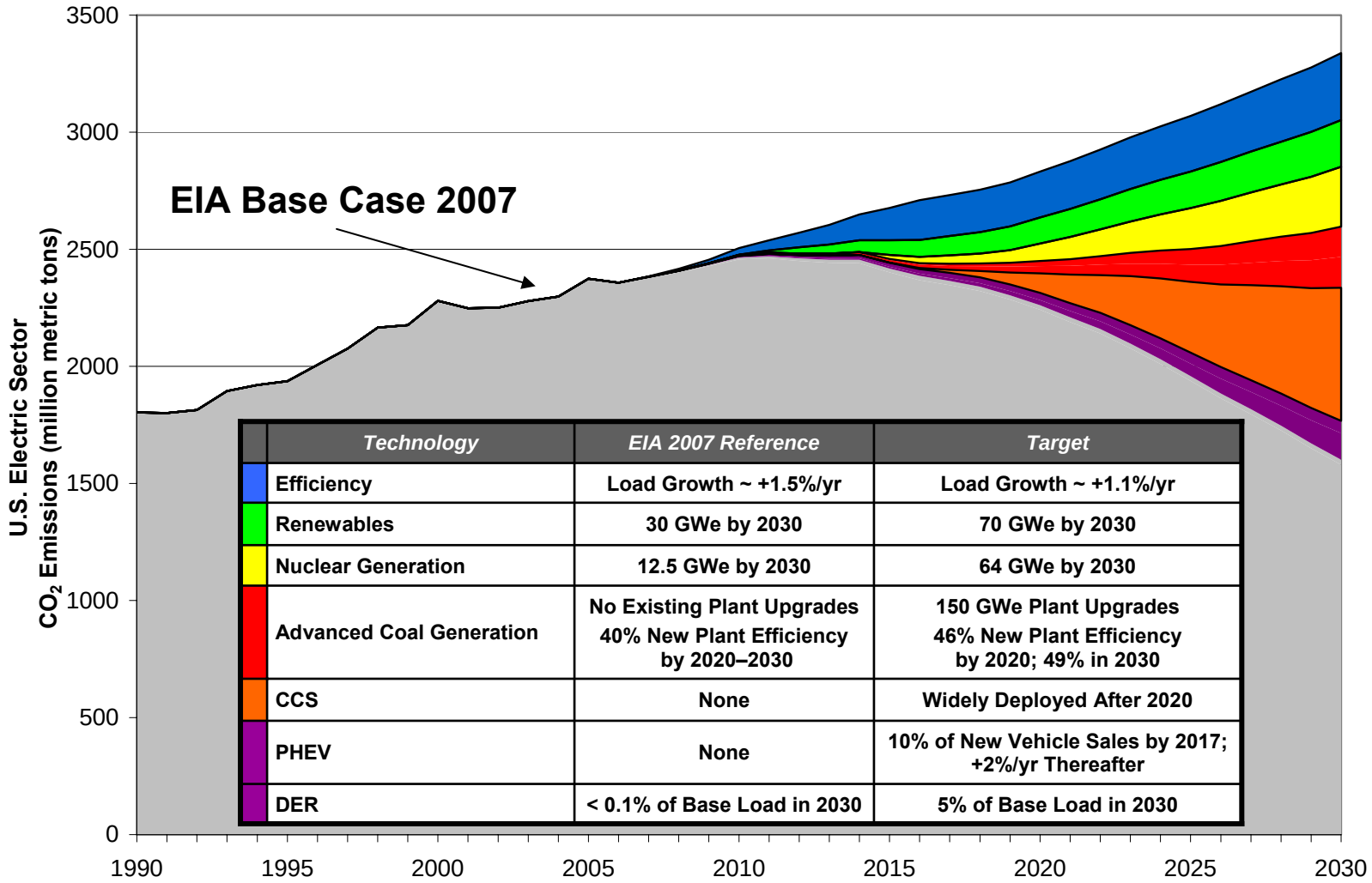
Consumers are demanding change

Regulators and policy makers are demanding action



Utilities are responding

How critical is the research --CO_2 Reductions



Technology	EIA 2007 Reference	Target
Efficiency	Load Growth ~ +1.5%/yr	Load Growth ~ +1.1%/yr
Renewables	30 GWe by 2030	70 GWe by 2030
Nuclear Generation	12.5 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Existing Plant Upgrades 40% New Plant Efficiency by 2020–2030	150 GWe Plant Upgrades 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

** Achieving all targets is very aggressive, but potentially feasible.*

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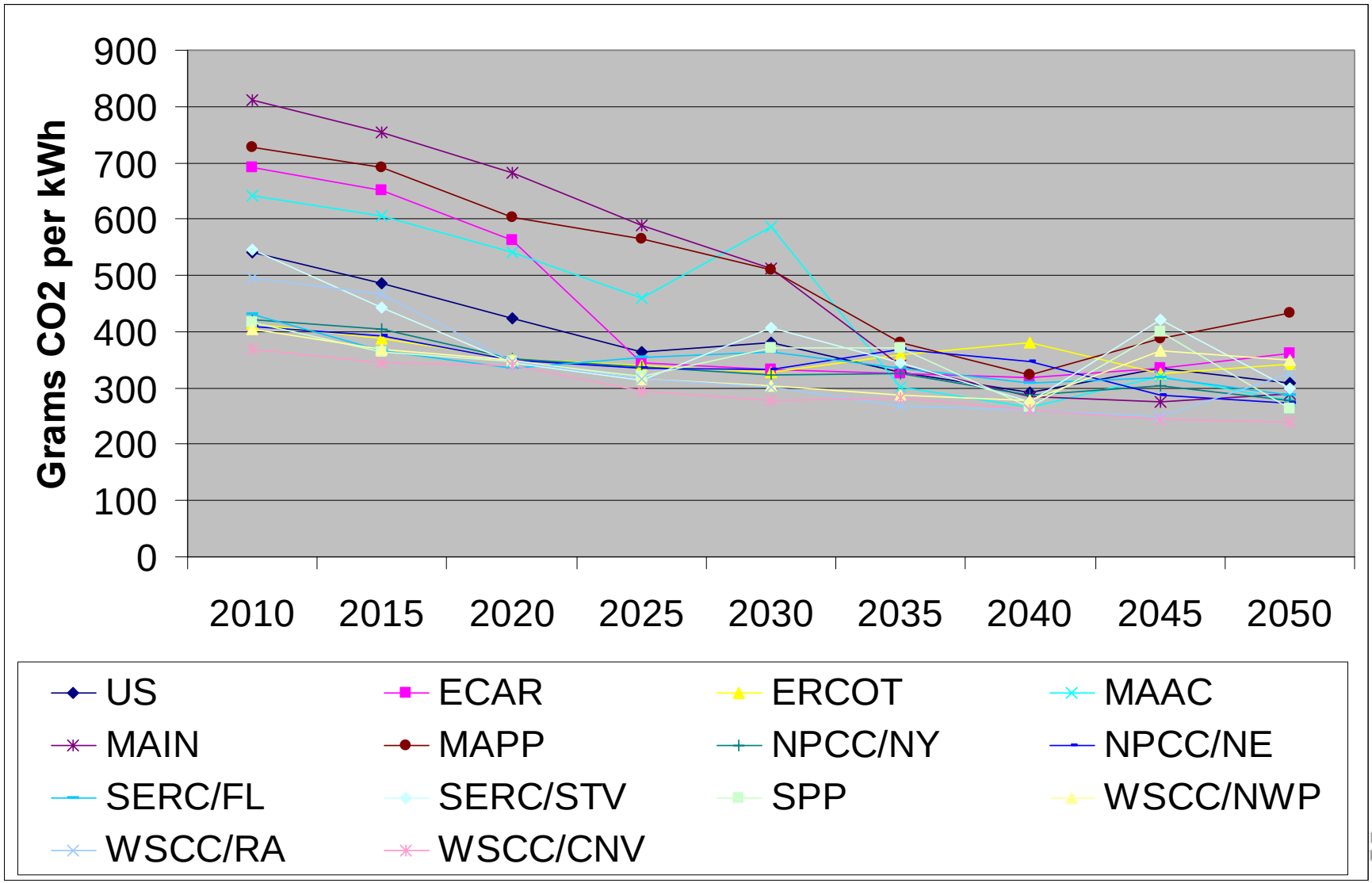
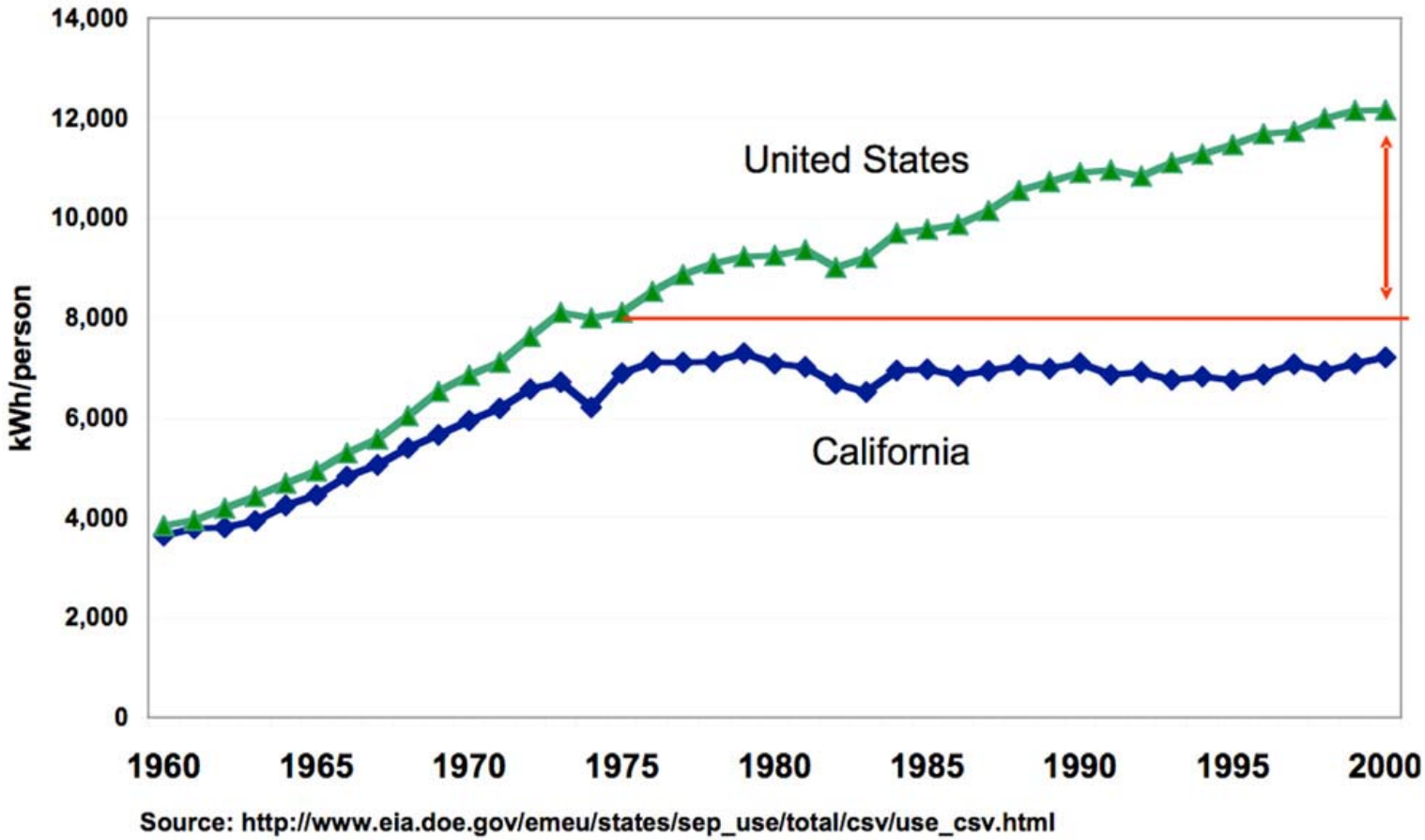
CO_2 Intensity Results for NERC Regions and Subregions



Can Energy Efficiency happen --- Per Capita Electricity Consumption



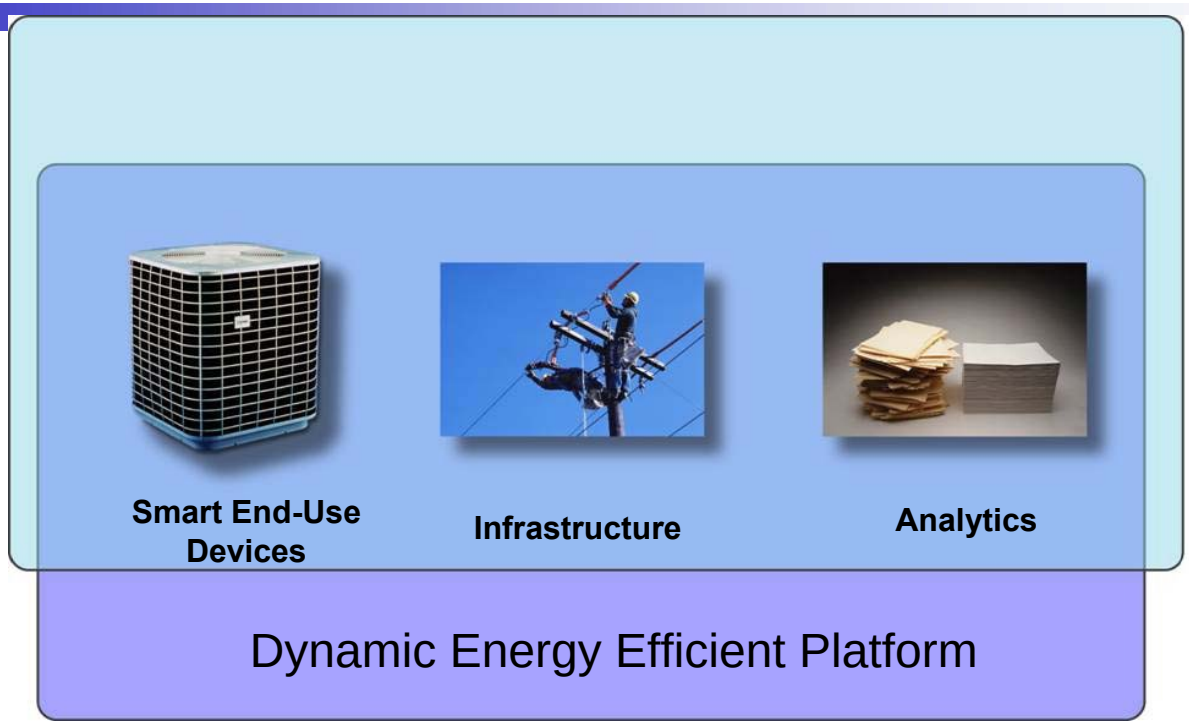
Source: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv.html

Top Utility Energy Efficiency Programs-GWH Savings (1992 to 2005) with CO2 Savings

Company	*GWH*	*Tons/MWH**	*M-Tons CO2*
• Southern California Edison	8,901	0.32	2,848
• Pacific Gas & Electric	6,233	0.32	1,995
• Northern States Power	3,787	0.66	2,499
• Florida Power & Light	3,664	0.54	1,979
• Connecticut Light & Power	2,119	0.35	742
• Puget Sound Energy	2,086	0.29	605
• PacificCorp	2,052	0.55	595
• Massachusetts Electric	1,991	0.35	697
• Boston Edison	1,346	0.35	471
• Interstate Power & Light	1,136	0.84	954
• Minnesota Power	893	0.66	589
• MidAmerican Energy	657	0.66	434

*Based on CO2 footprint of the NERC reliability region for 2006

Energy Efficiency Initiative



- **Successful launch on January 31, 2007**
- **28 utilities have signed agreements to participate**
- **5 additional utilities have agreements**
- **Utility Advisory Team with an Executive Council and Working Groups will provide strategic oversight**
- **Goal of $5M and 40 utilities to support the collaboration**

Participating Utilities

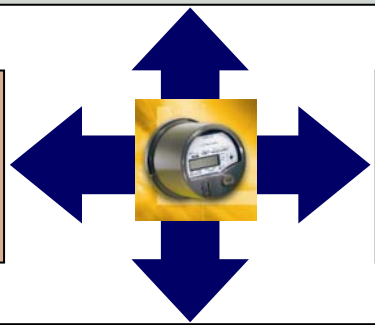
AEP
Arkansas ECC
Avista
BPA
CenterPoint Energy
Central Hudson G&E
ConEd of NY
CPS Energy
Dominion
Duke
First Energy
Florida Power & Light
Great River Energy
Kansas City P&L
LIPA
Nebraska PPD
Northeast Utilities
NYPA
MidAmrican
PNM
PSE&G
SCE
Seattle City Light
SMUD
Snohomish PUD
Southern Co.
Southwest Power
SRP
Tri-State G&T
TVA
WE Energies
Integrys Energy Group
Xcel Energy

Strategy -- Intelligent Electricity Delivery Infrastructure

Four Building Blocks

Communications Infrastructure

Innovative Regulation and Rates



Innovative Markets

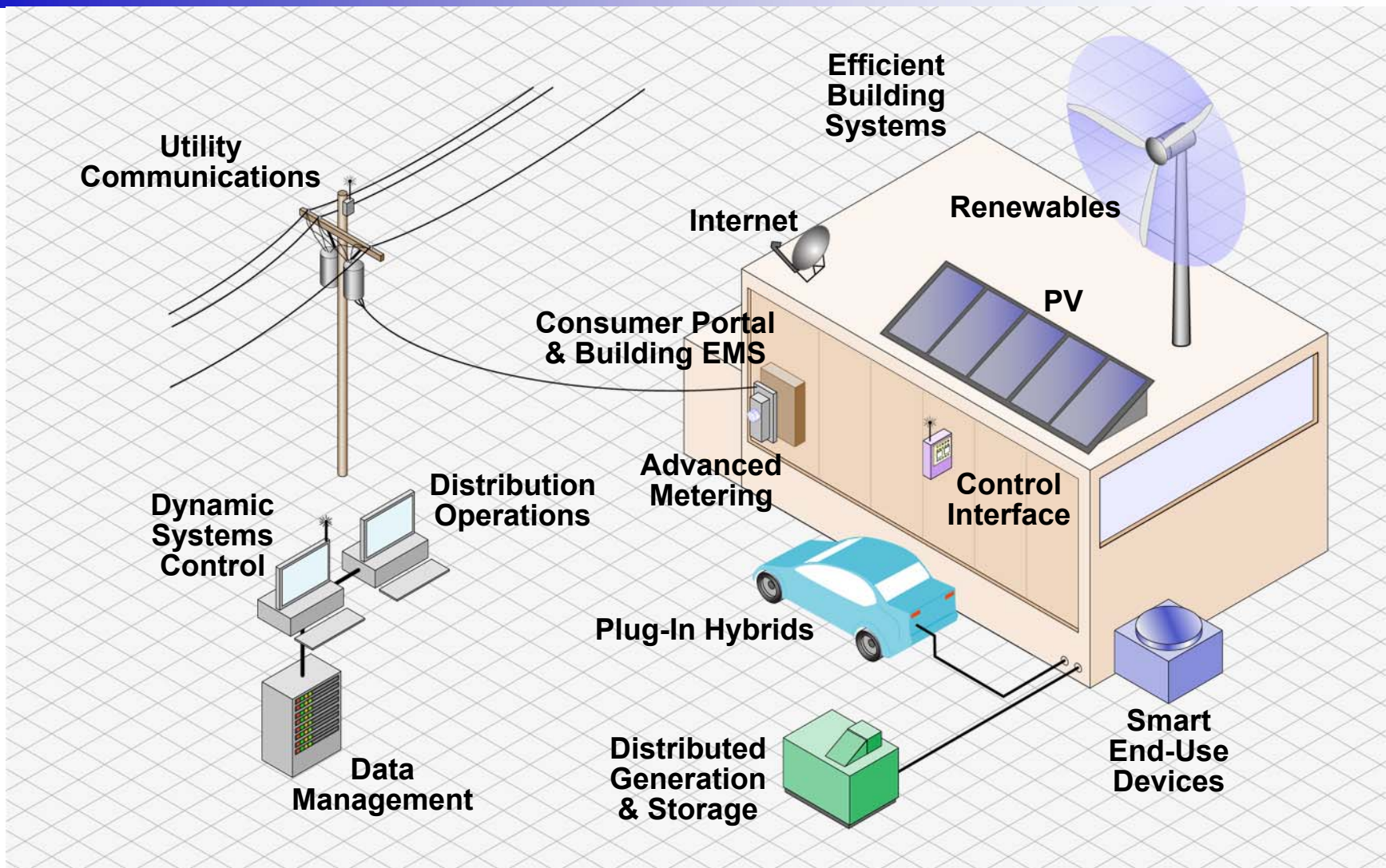
Efficient and Smart Electrical Devices

DER

AC with PCT

PHEV

Dynamic Energy Management System



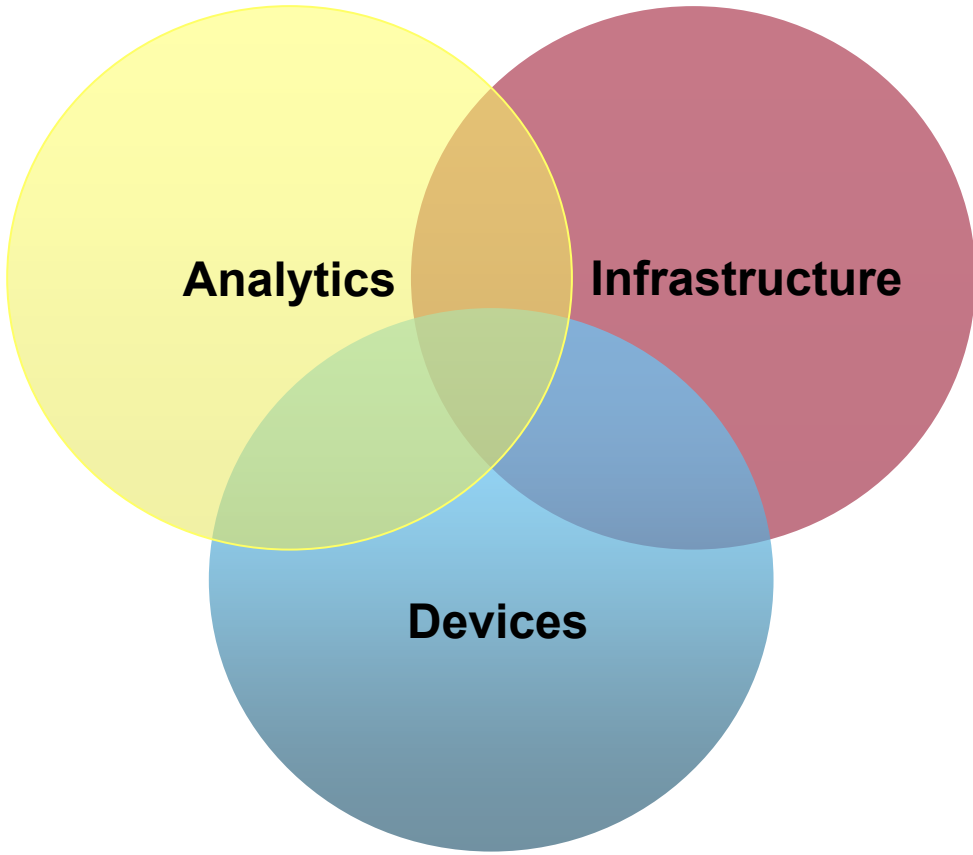
Energy Efficiency Initiative Program Elements

The Dynamic Energy Management Structure

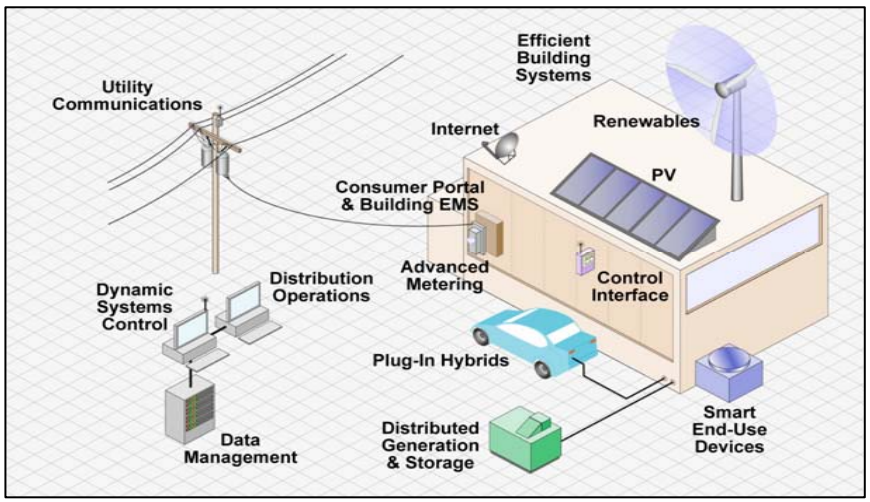
Analytics
- Technical, economic and environmental tools and assessments

Infrastructure
- The enabling communication and control system

Devices
- Identifying & influencing design of new smart and efficient devices and equipment



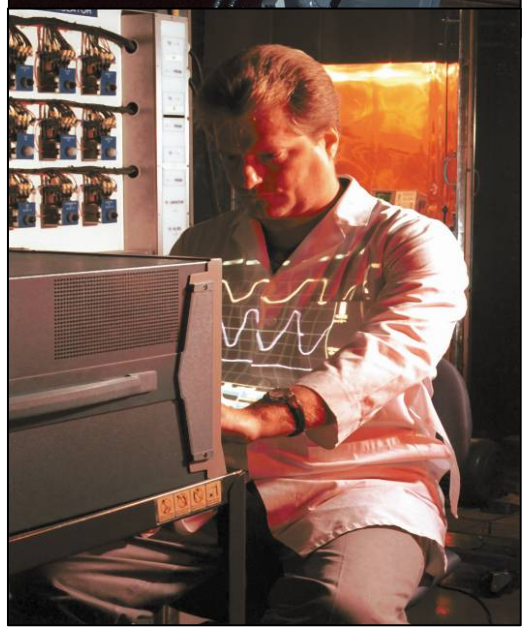
Analytics: Economic and Environmental Data



- Credible data on economic and environmental impact of enabling smart end-use devices
- T&D impacts assessment
- Market simulation tools

Infrastructure: Establish field readiness of systems

- Develop the Vendor Network
- Develop the Living Laboratory – the intent is to lead field deployments
- Identify high-value applications for testing and demonstration, for example:
  - AMI systems
  - Programmable thermostats
  - IP addressable smart end-use devices such as dimmable LEDs
  - Evaluate interoperability of devices and systems



Devices – Focus on Commercial & Industrial Sector

- **Commercial building intelligence**:
  Preliminary specs and protocols for standardized interface for building controls
- **Efficient C&I technology data repository** to assist utilities with information to aid in implementing energy efficiency and demand response activities

Future Deliverables

- **Vendor Network: Assembled and categorized options**
- **Living Laboratory: Evaluated options**
- **Dynamic energy management requirements: Extracted from pilot field tests**

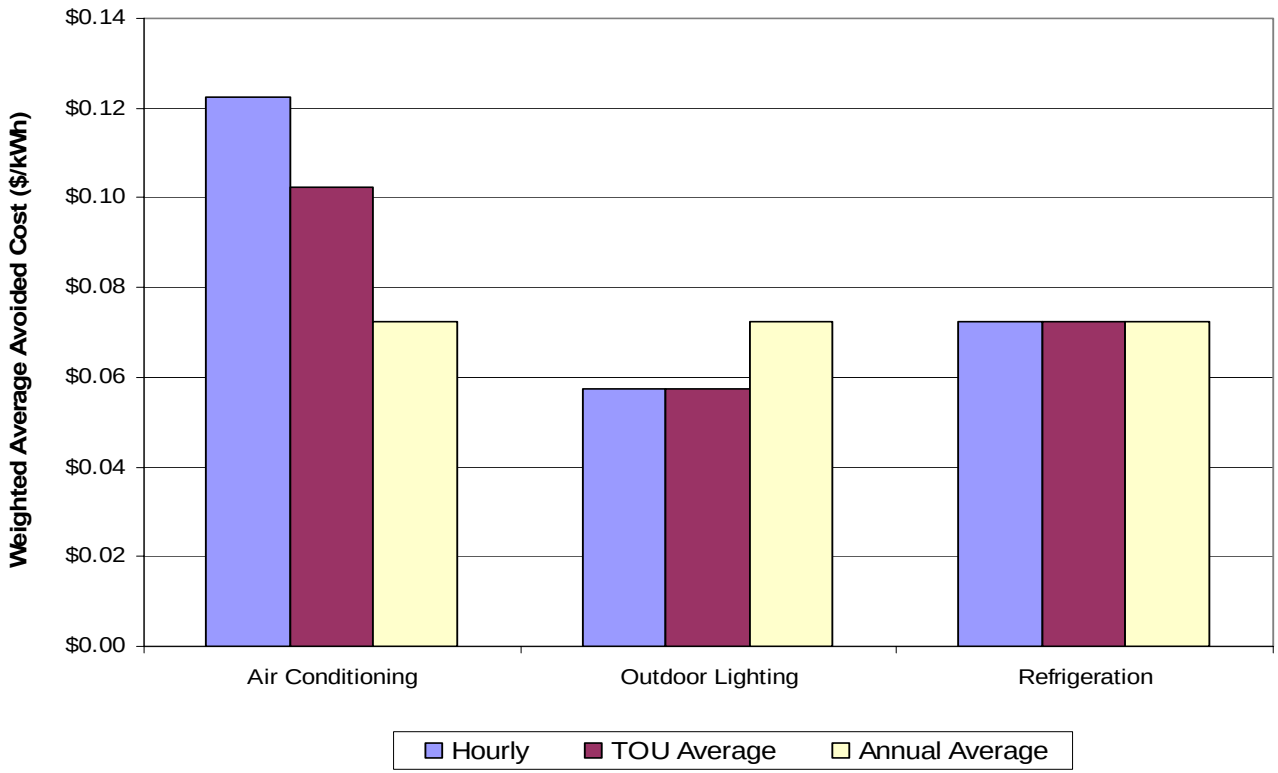
Goal: Create the environment where energy efficiency happens due to market response

Non-Technology Challenges to Successful Energy Efficiency Programs

- Market transformation
- Third party commercial participants
- Pricing and rates
- Utility disincentives and incentives
- Develop standards

Why Use Time Differentiated Rates

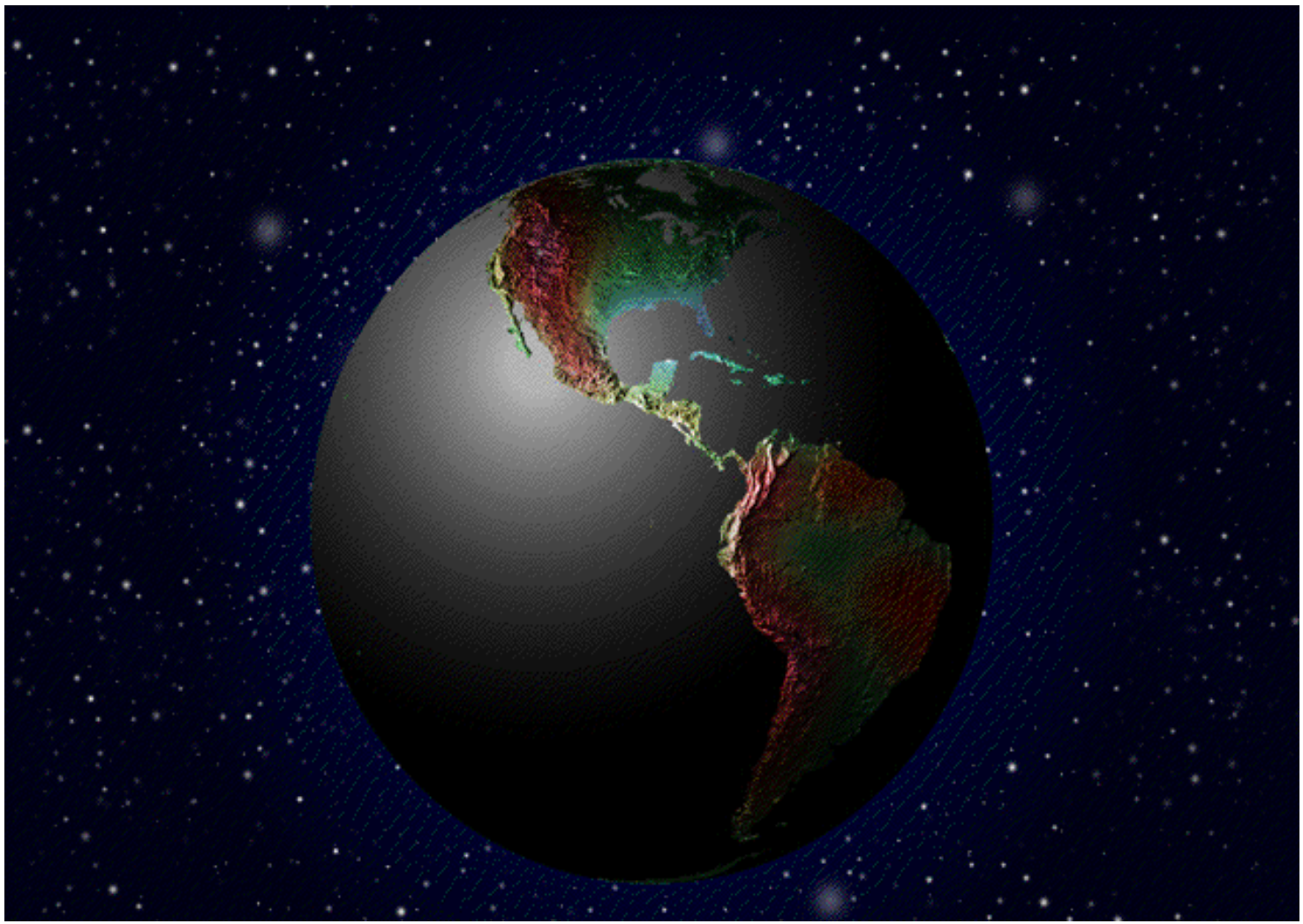
Marginal Pricing creates the market for consumers to adopt energy efficiency measures



Questions

- What is the best role for us to play in assisting market transformation?
- What steps can we take to help the public recognize the value and the urgency of committing to energy efficiency?
- What can you do to help achieve widespread adoption?
  - Pricing
  - Utility costs, revenues, and profits
  - Support R&D

Key Challenge – Save this world!



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IntelliGrid

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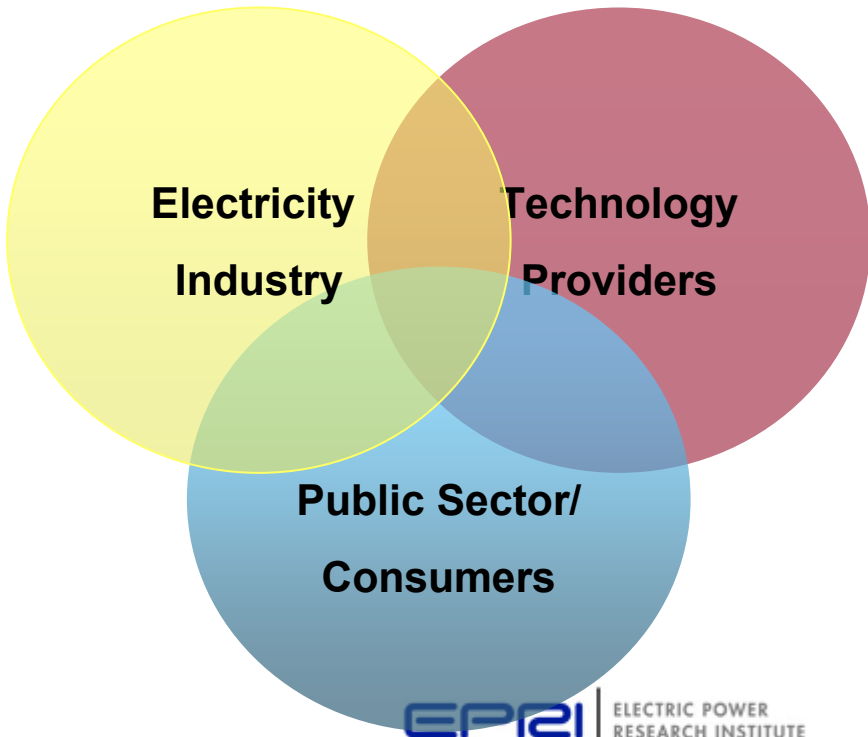
Background – EPRI's IntelliGrid Program

Mission: To accelerate the transformation of the power delivery infrastructure into the intelligent grid needed to support the future needs of society

Pathway to the Intelligent Grid

- Create the vision
- Identify the barriers for achieving the vision
- Conduct research, development and demonstrations aimed at overcoming the barriers



IntelliGrid Partners Cut Across All Stakeholder Groups

U.S. Utilities

- Kansas City Power & Light
- Long Island Power Authority
- New York Power Authority
- Salt River Project
- TXU
- Public Service New Mexico
- Duke Energy
- CenterPoint
- First Energy
- Hawaiian Electric
- Others

International Utilities

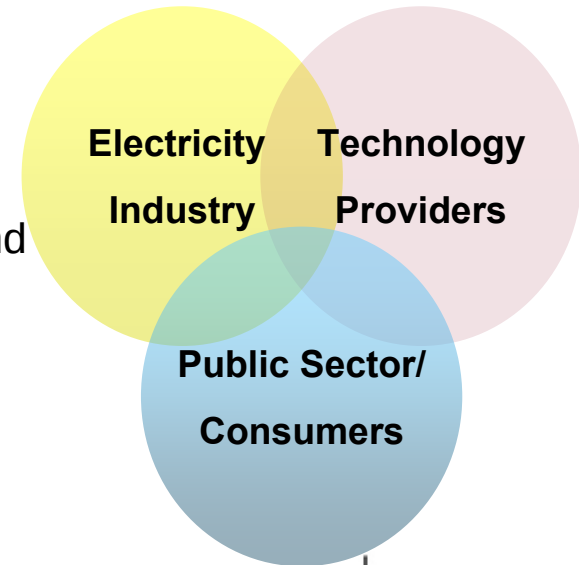
- Electricite de France
- Polish Power Grid Company
- Korea Electric Power

Public Agencies

- Association of State Energy Research and Technology Transfer Institutions
- International Brotherhood of Electrical Workers
- National Association of Regulatory Utility Commissioners
- National Association of State Energy Officials
- National Conference of State Legislatures
- National Governors Association
- State Energy Offices and Research Programs

Manufacturers

- ABB
- Hitachi



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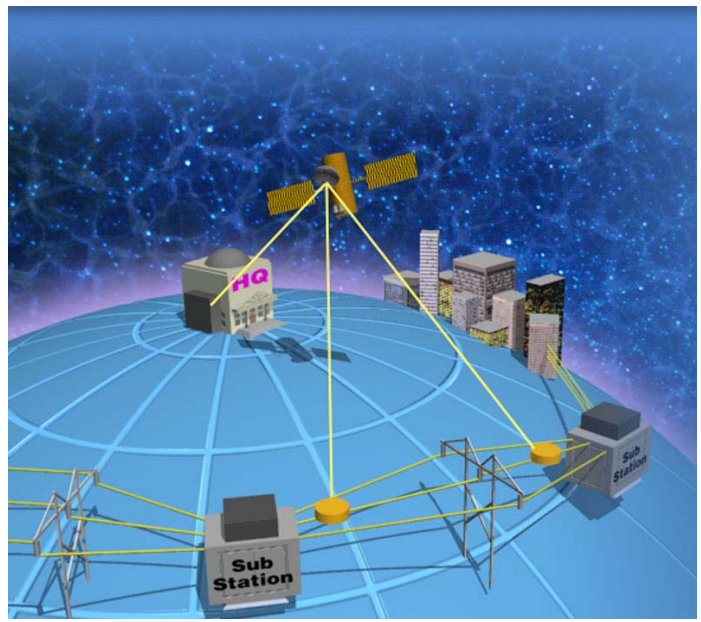
The Power Delivery System of the Future: *Characteristics*

- *Interactive* with consumers and markets
- *Self-Healing* and *Adaptive*
- *Optimized* to make best use of resources and equipment
- *Predictive* rather than reactive
- *Accommodates* a variety of generation options
- *Integrated*, merging monitoring, control, protection, maintenance, EMS, DMS, marketing, and IT
- *More Secure*



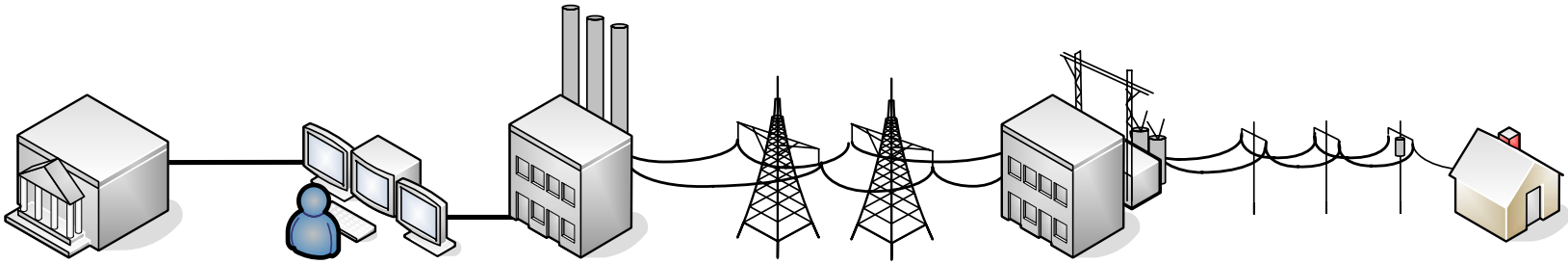
The Power Delivery System of the Future: *Benefits*

- Greater system *reliability*, *functionality*, and *consumer value*
- Enable *demand response* and *energy efficiency*
- Accelerated rate of reduction of *carbon emissions* through optimized use of assets
- Increased *economic productivity*

The Power Delivery System of the Future
Key Technologies

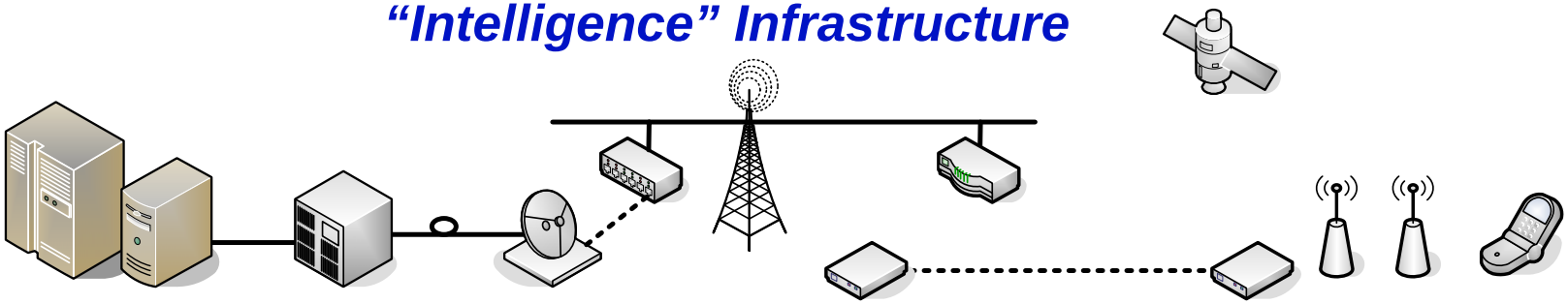
- Communications
- Monitoring
- Embedded Computing

Achieving the Power Delivery System of the Future:
Integrating Two Infrastructures

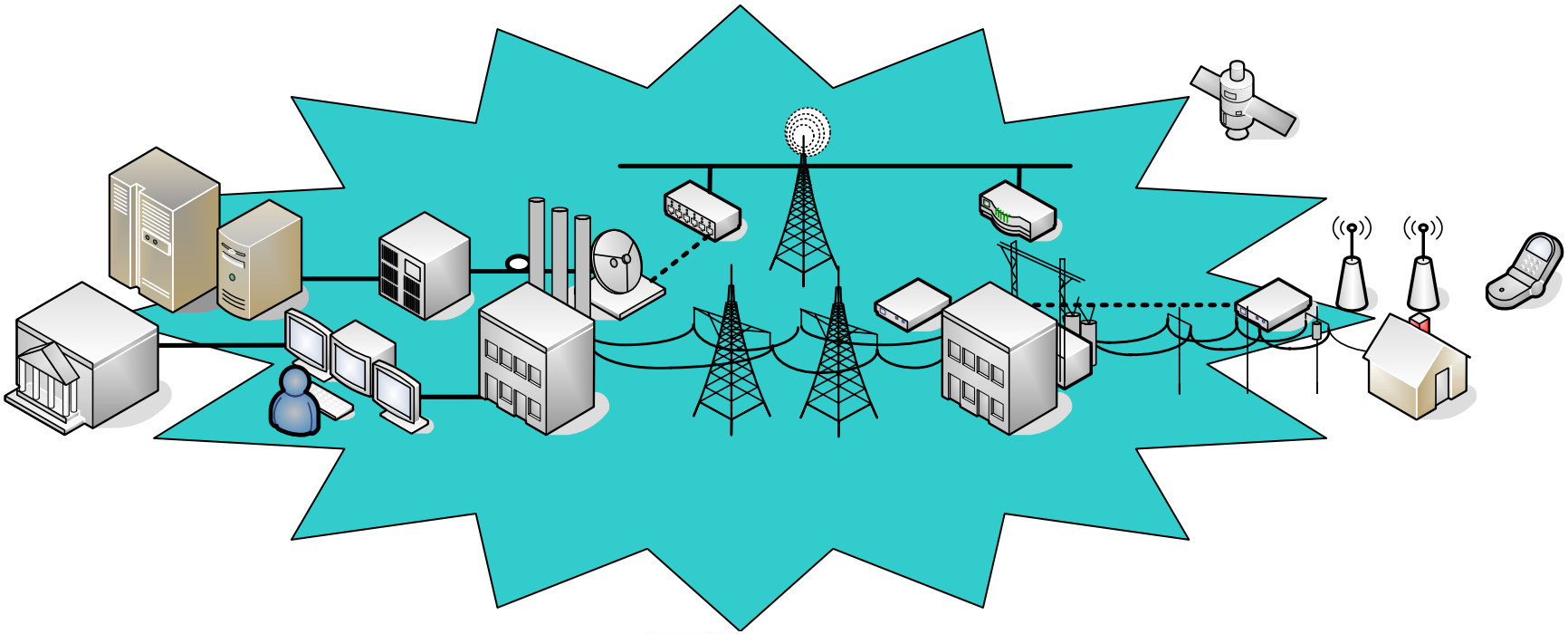


Electrical Infrastructure

"Intelligence" Infrastructure

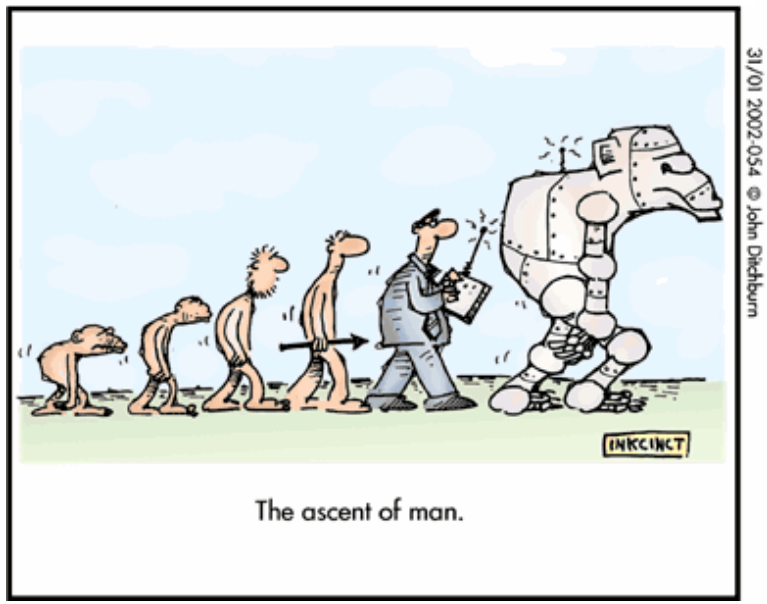


The Intelligent Grid

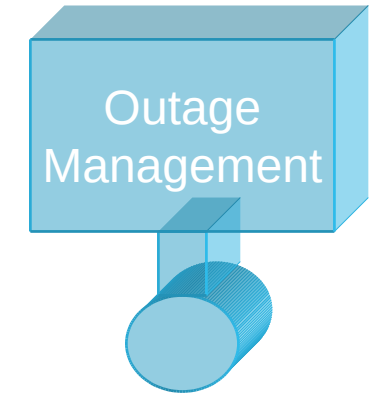


How is an Intelligent Grid Created?
The Premise

- ***Evolve*** over many years
- Incremental deployment and integration of ***intelligent systems***
- Deployed to meet specific business and regulatory ***drivers***



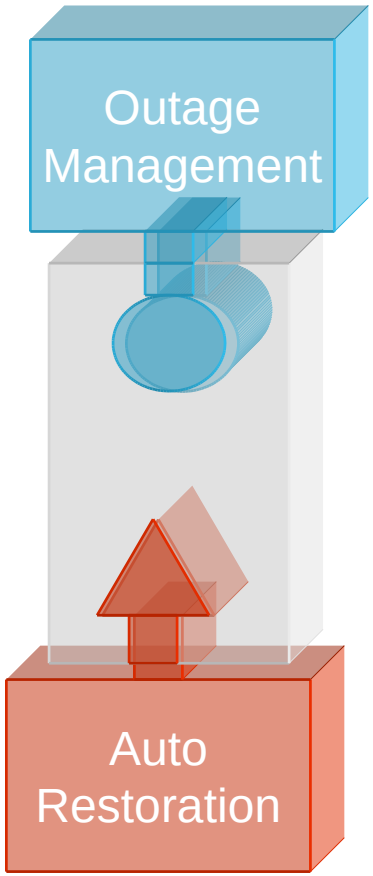
How is it Done Today?



- Utilities currently tend to develop intelligent systems in isolation
- Neither project is typically developed with the other in mind.

How is it Done Today?

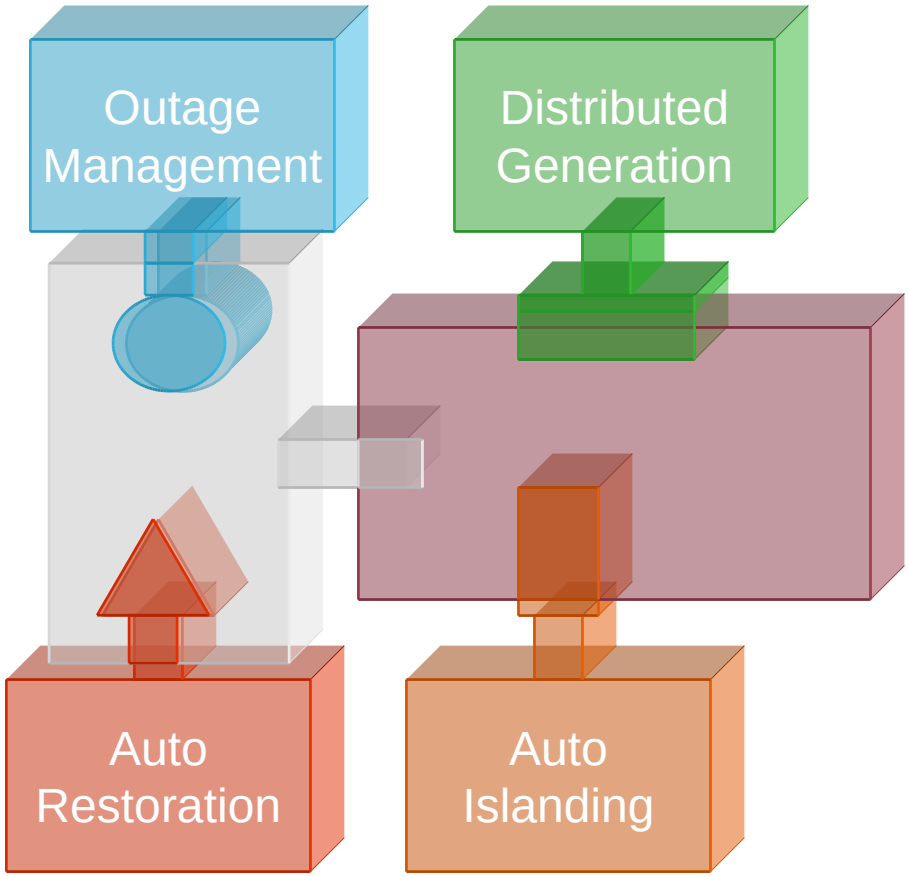
One-Off Integration



- Integration is typically done after the fact
- Cost is significant

How is it Done Today?

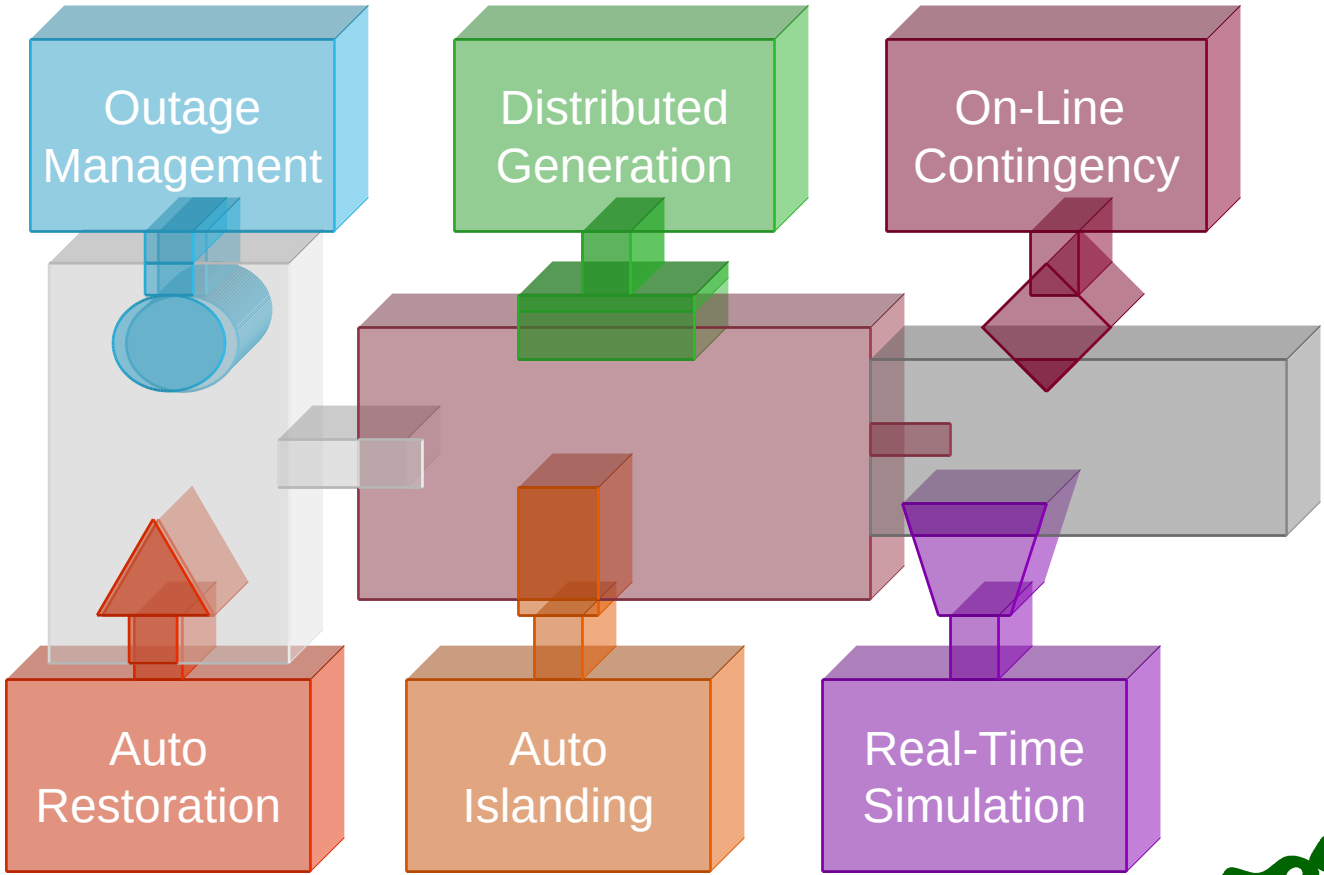
Doing it the Next Time



- Now want to link in new systems
- Must first make the old system expandable
- Then must do another “one-off” integration

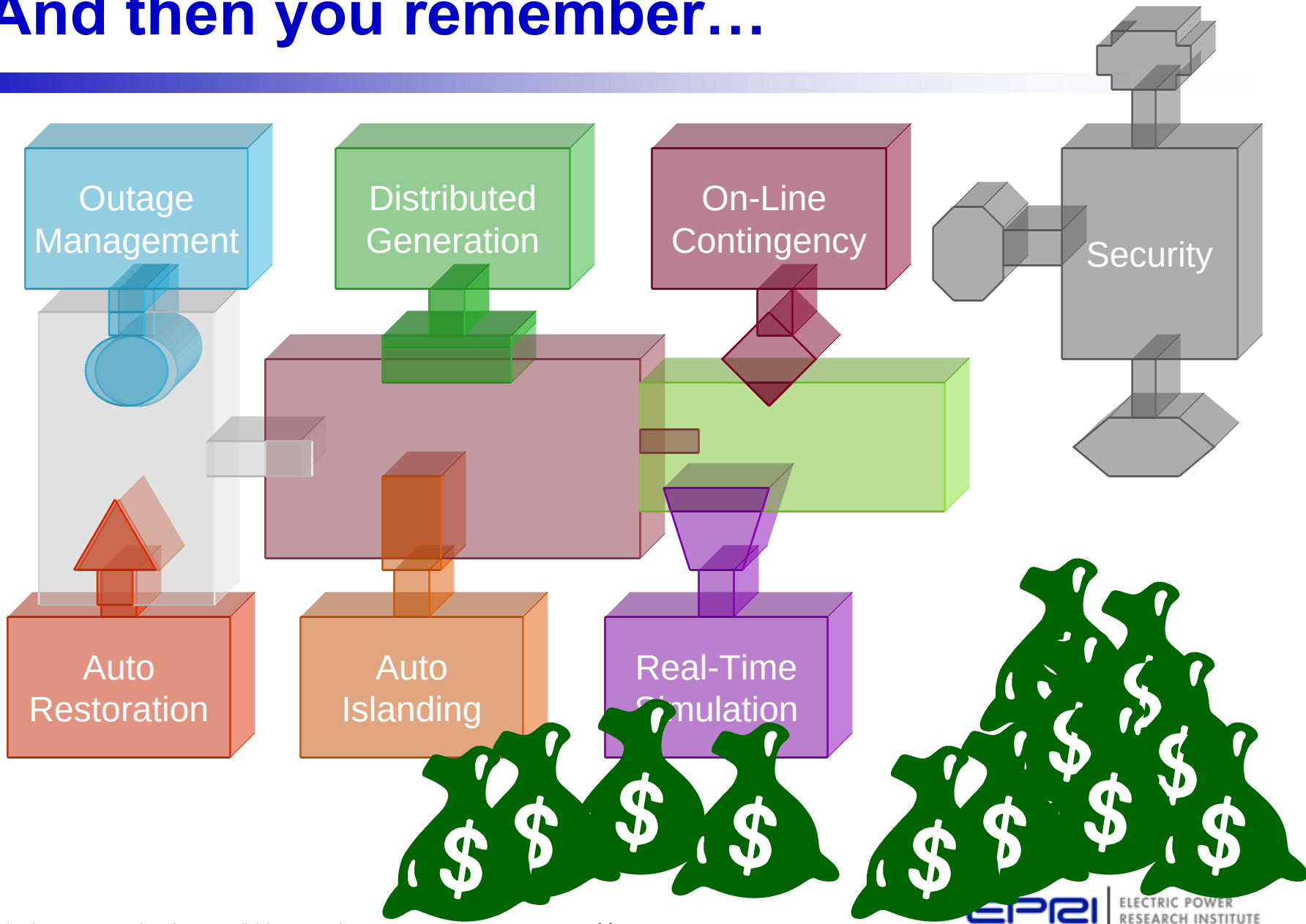
How is it Done Today?

And again…



How is it Done Today?

And then you remember…



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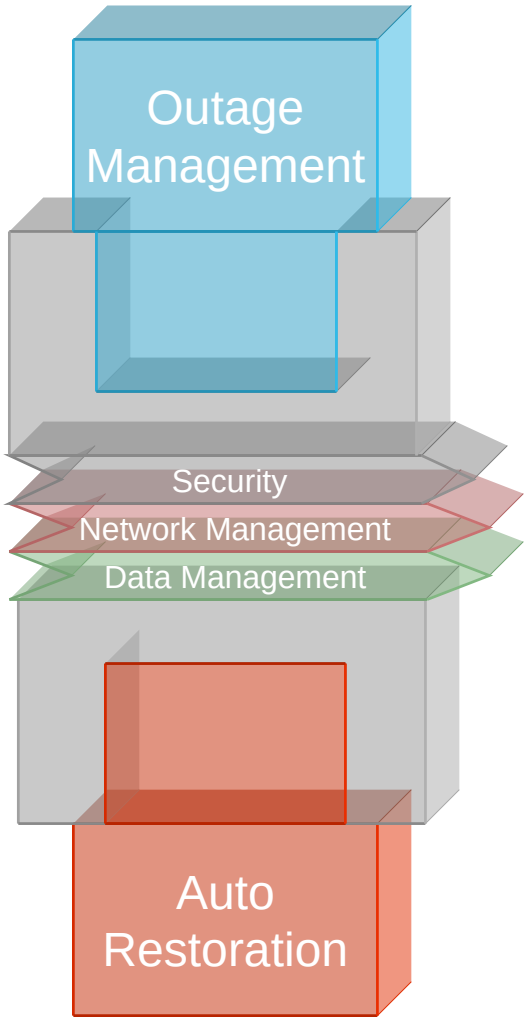
A Better Way: Top-Down Design



- Determine requirements first
- Define standardized interfaces
- Incorporate security, network management and other strategies right from the beginning
- Initial costs are a bit more than one-off integration, but not much more
- New applications can build directly to the new architecture

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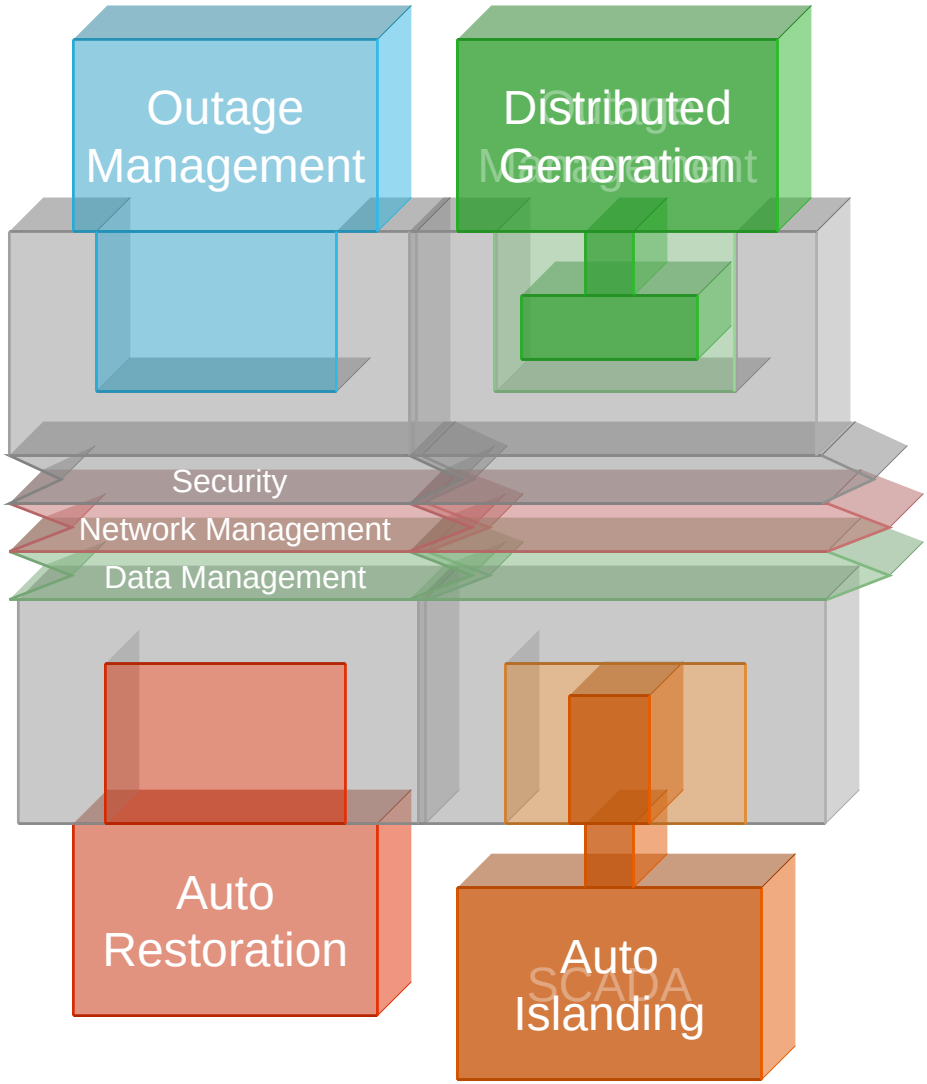
A Better Way: The Next Phase



- Can re-use the development from the first phase
- Expansion was expected
- Adaptation to legacy systems was planned in advance
- Overall costs much lower

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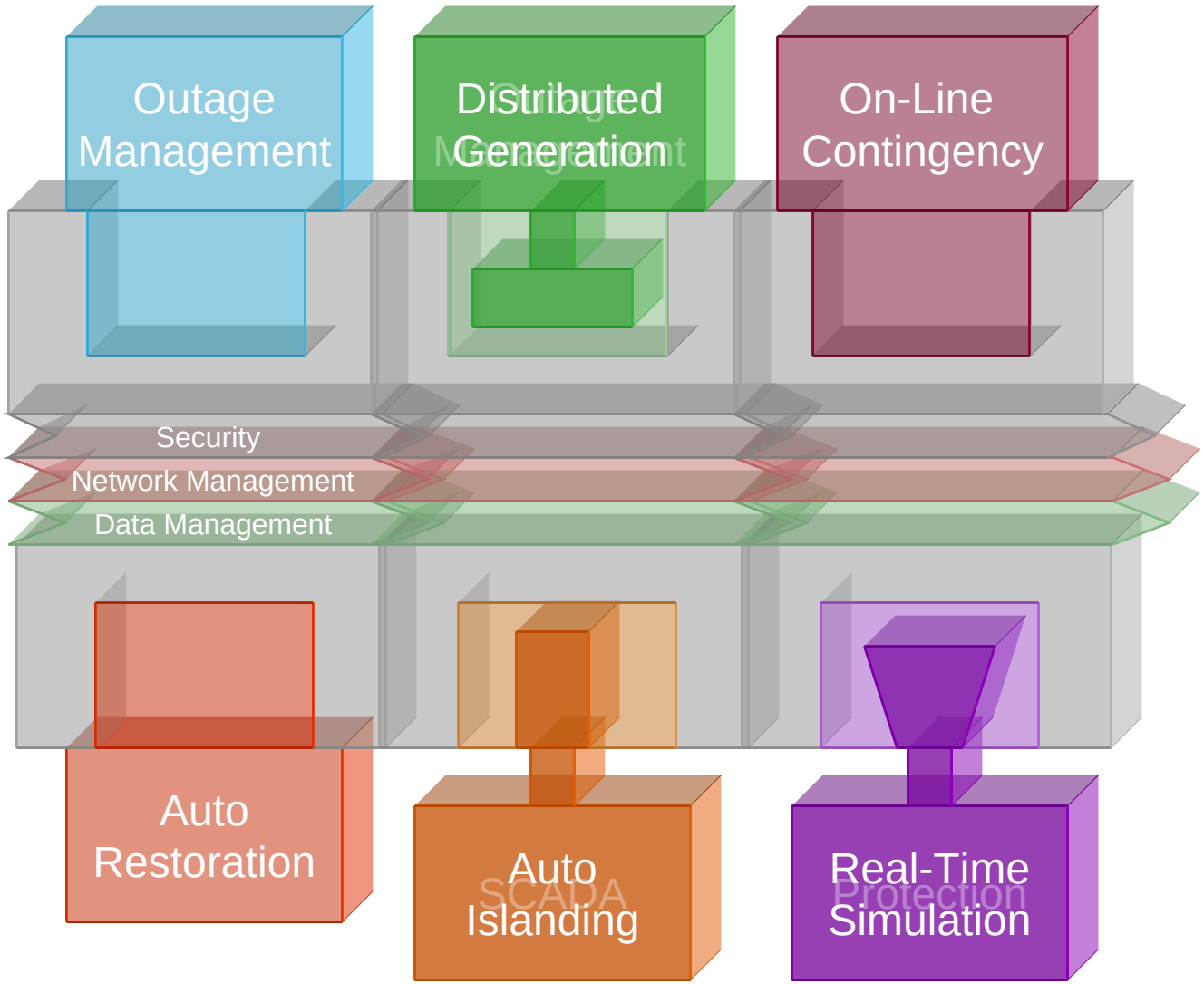
A Better Way: And so on…



- Benefits INCREASE with time
- Opposite of the old way

Achieving the IntelliGrid Vision:
Barriers

- Utility practices and culture
- Business case for building infrastructure
- Integration methods and tools
- Standards
- Suppliers

EPRI's IntelliGrid Program

- Develops the methods, tools and integrating technologies that enable utilities to efficiently and cost effectively deploy "intelligent system" today
  - Meet near-term needs while laying the foundation for the intelligent grid of the future
- Assists members in implementing results
- Coordinates with other "smart grid" R&D activities

IntelliGrid℠

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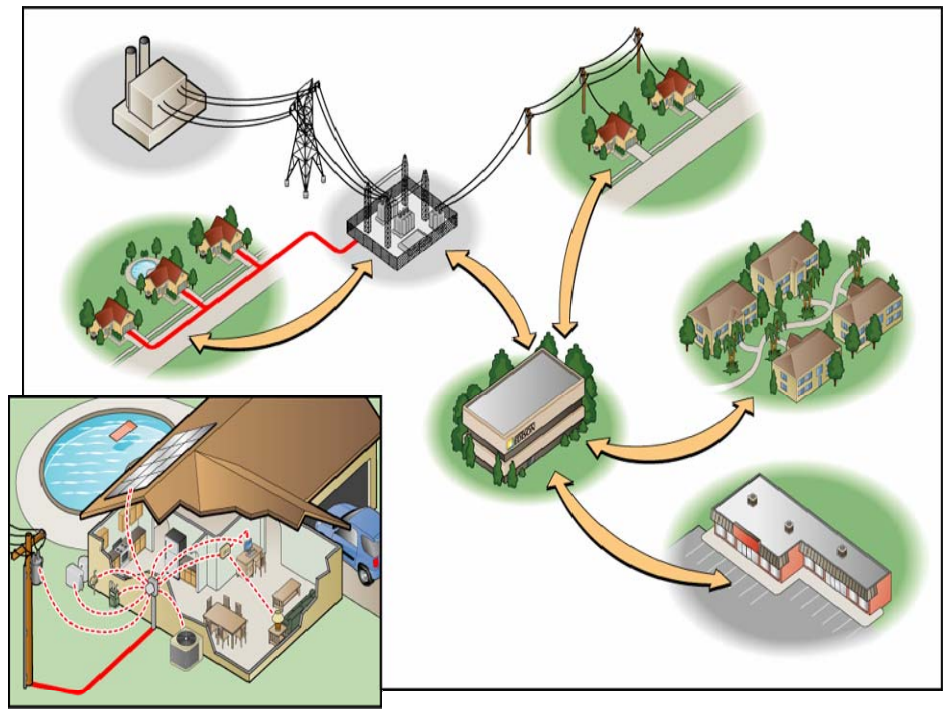
The IntelliGrid Architecture

- Provides the methods, tools, best practices and recommendations for specifying “intelligent” systems in such a way as to promote:
  - Interoperability
  - Flexibility
  - Effective security and data & system management
  - Expandability

Applying the IntelliGrid Results
Case Study: Southern California Edison

Advanced Metering Infrastructure

- Apply methods & tools to capture requirements
- Apply approach for mapping requirements to technologies
- Apply recommendations for standards and technologies
- Contribute the results of their work to the industry



Key 2007 R&D Activities

- Communications and Computing Architecture
- Advanced Monitoring and Sensor Technology
- Communications Technology Assessment
- Infrastructure to Support Demand Response and Energy Efficiency
- Application Guidelines & Training Materials
- Smart Grid “Roadmap”

Questions

- How can the public sector help achieve the intelligent grid?
- What can we do to help you?