EPRI | ELECTRIC POWER RESEARCH INSTITUTE

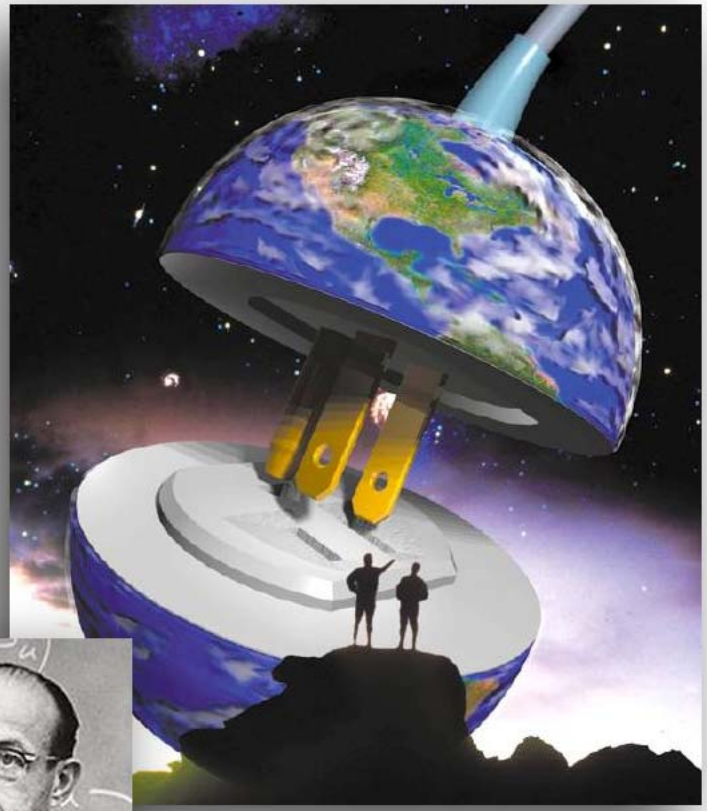
The ElectriNet…
Creating the Electricity Network of the Future

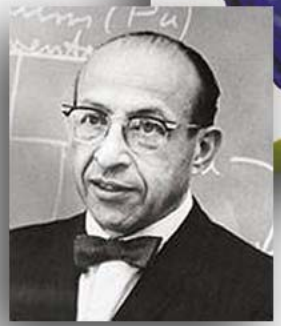
National Association of Regulatory Utility Commissioners
Electricity Committee
November 17, 2008

Rob Chapman
Vice President,
Technical Advisory Services

Our History…

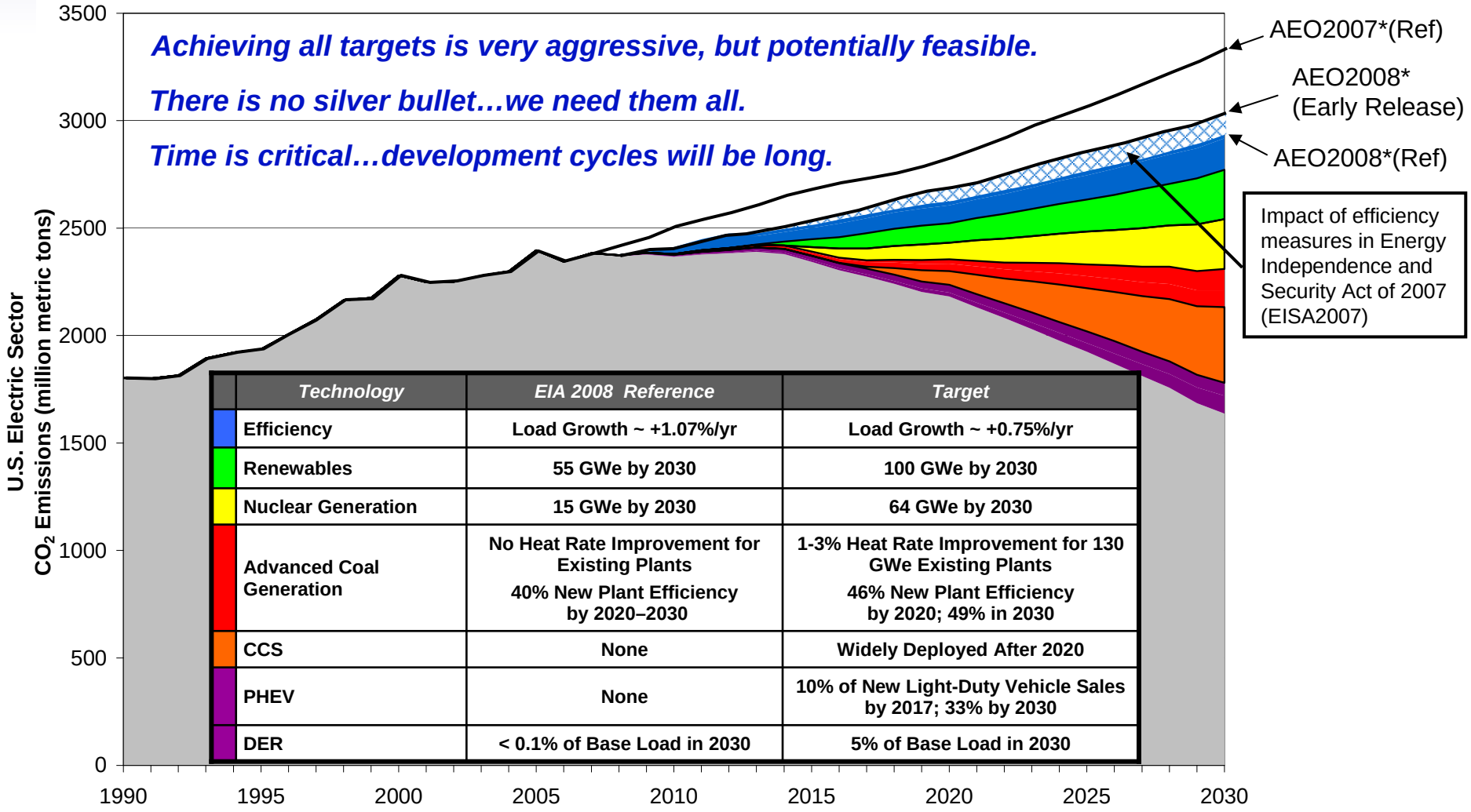
- Founded by and for the electricity industry in 1973
- Independent, nonprofit center for public interest energy and environmental research
- **Collaborative** resource for the electricity sector
- Major offices in Palo Alto, CA; Charlotte, NC; Knoxville, TN
  - Laboratories in Knoxville, Charlotte and Lenox, MA





Chauncey Starr
EPRI Founder

Analysis Framework…2008 PRISM



Technology	EIA 2008 Reference	Target
Efficiency	Load Growth ~ +1.07%/yr	Load Growth ~ +0.75%/yr
Renewables	55 GWe by 2030	100 GWe by 2030
Nuclear Generation	15 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Heat Rate Improvement for Existing Plants 40% New Plant Efficiency by 2020–2030	1-3% Heat Rate Improvement for 130 GWe Existing Plants 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Light-Duty Vehicle Sales by 2017; 33% by 2030
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

*Energy Information Administration (EIA) Annual Energy Outlook (AEO)

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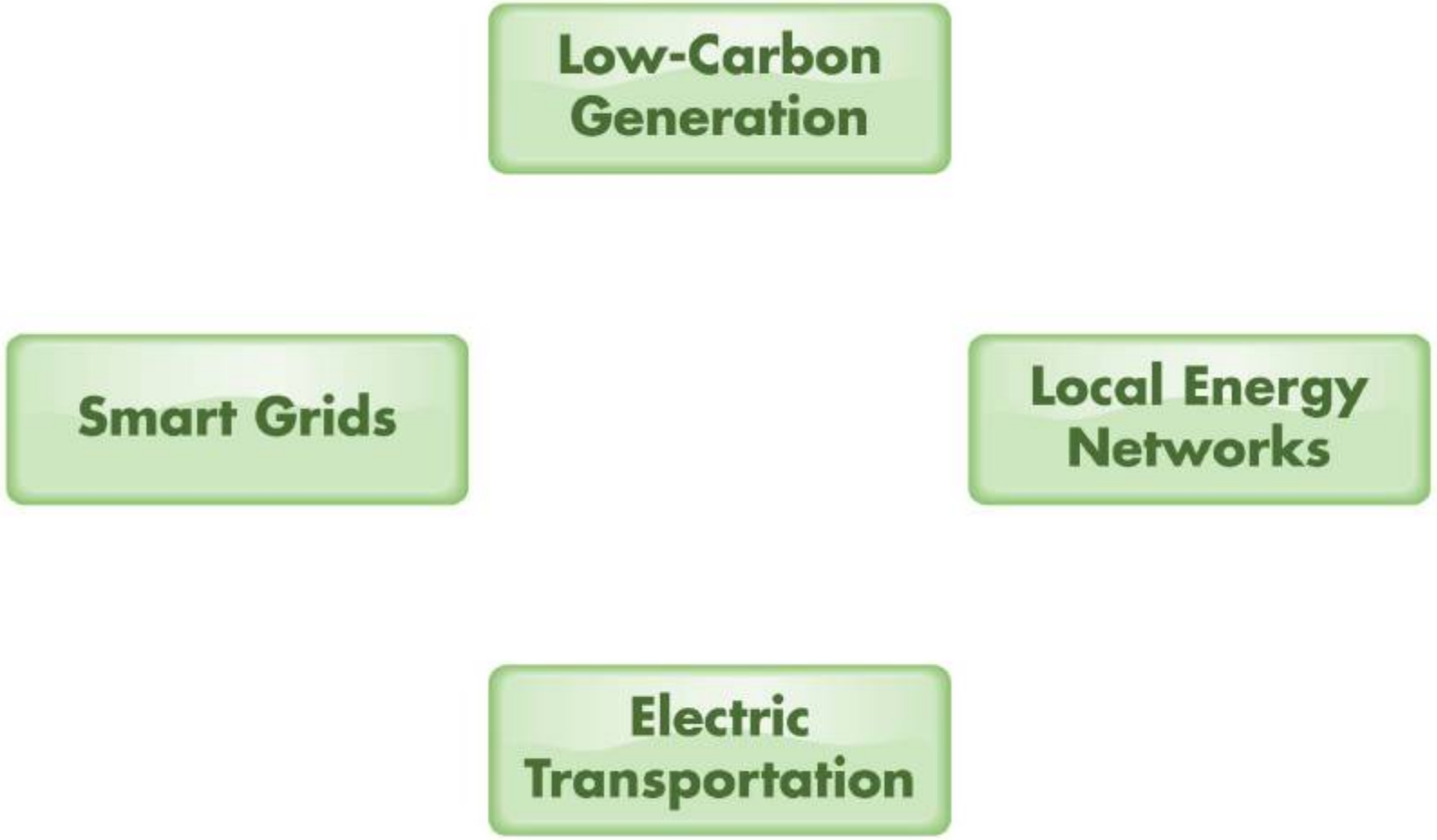
Implementing a Low-Carbon Infrastructure

Four Evolving Infrastructures



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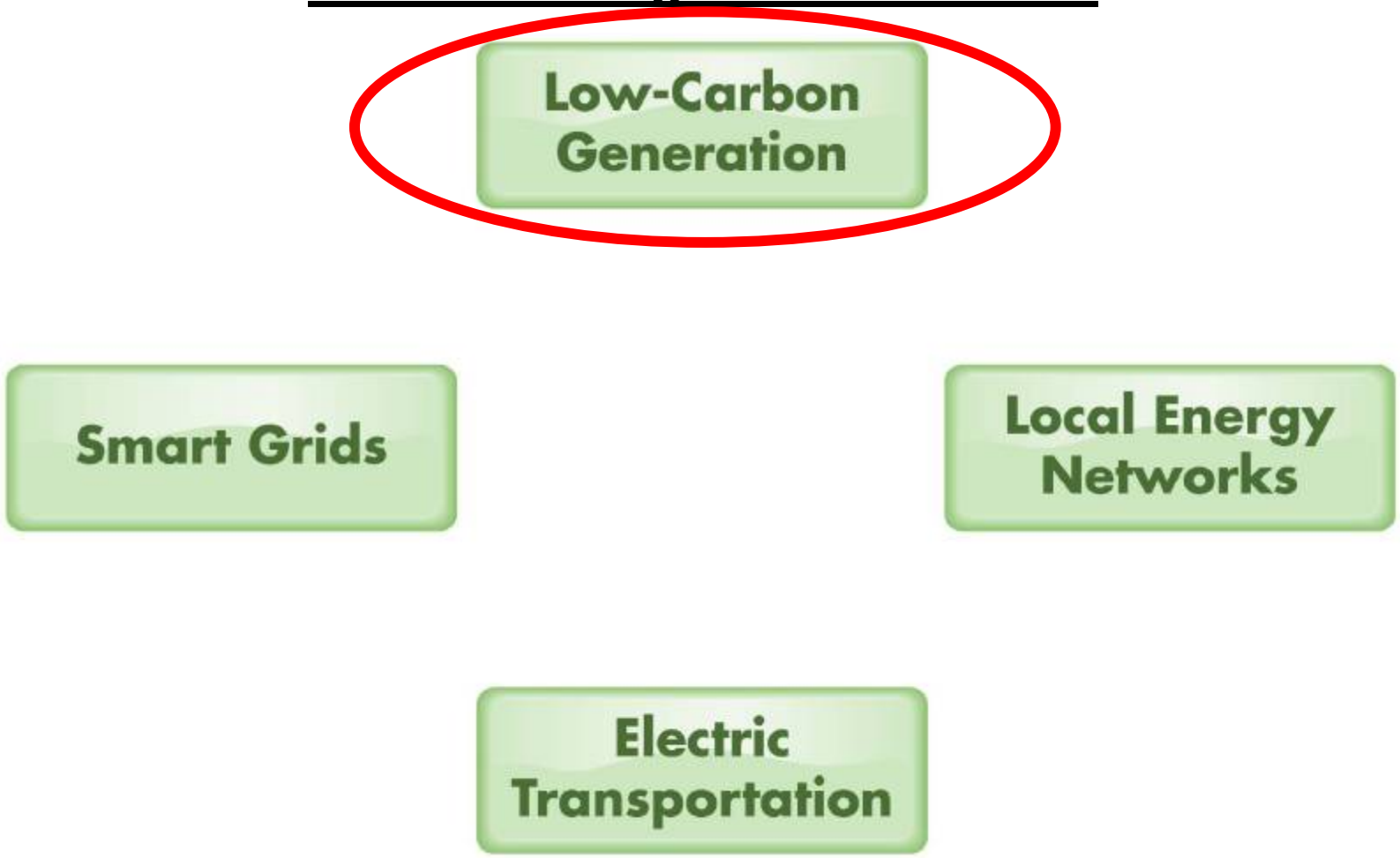


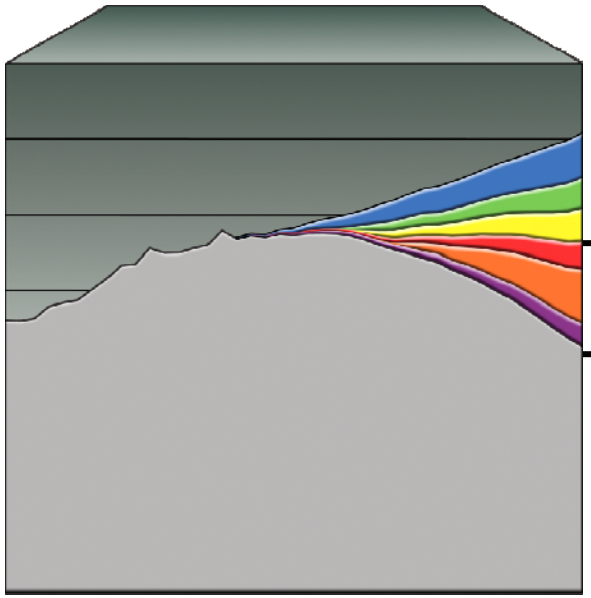
Transitioning to Low-Carbon Infrastructure

- Large-Scale Wind, Solar, Geothermal and Biomass
- Large-Scale Energy Storage
- Natural Gas – Base-load and Peaking
- Nuclear – Advanced Light Water Reactors
- Advanced Coal with Carbon Capture and Storage
- Distributed Rooftop Solar



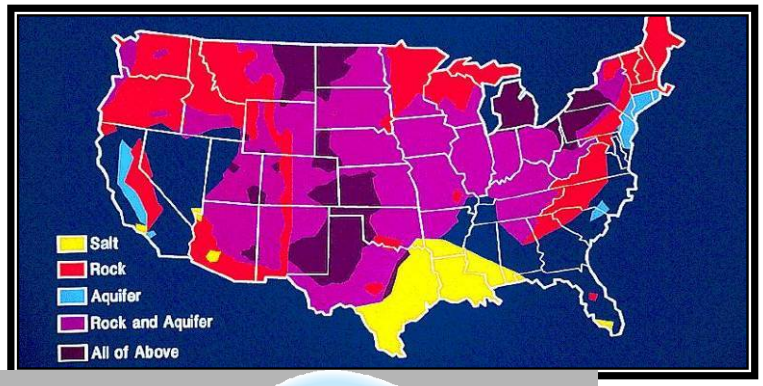

All Technology Options need to be Available…Economics and Policies will Eventually Determine the Mix

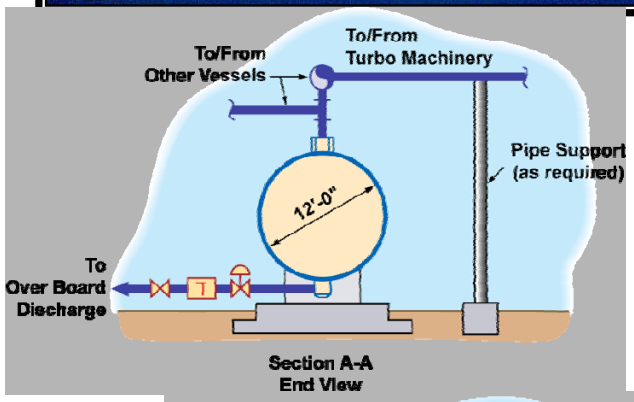
Industry Demonstration Projects… From Analysis to Action

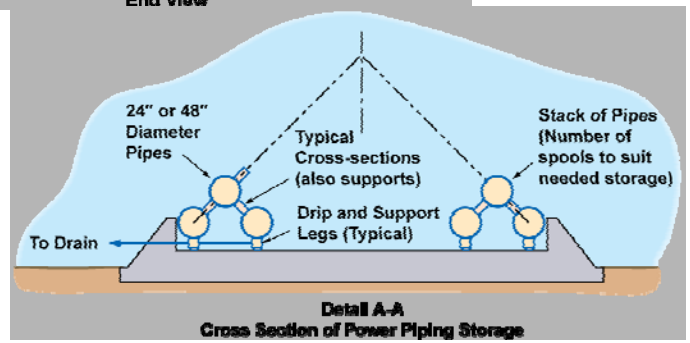


Technology Challenges	*Demonstration Projects*
1. Smart Grids and Communication Infrastructure	Energy Efficiency
	Smart Grids
	Compressed Air Energy Storage
3. Advanced Light Water Reactors	CCS Using Chilled Ammonia and a Different Technology
4. Coal-Based Generation Units with CO_2 Capture and Storage	IGCC with CCS
	Low-cost O_2 Production

Compressed Air Energy Storage (CAES)







Underground CAES

- Assess and Demonstrate Porous Rock/Aquifer Storage
- Plant Size: Above 300 MW

Above-Ground CAES

- Assess Economic Feasibility of Pipe and/or Vessel-Based Above Ground Air Storage
- Assess corrosion impact of cycling temperature and pressure
- Plant Size: 10-20 MW with 2-3 hours of storage

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Clean Coal- Demonstration Projects

Chilled Ammonia Pilot at We-Energies

Pilot Now In Operation

- Installed at We Energies' Pleasant Prairie Power Plant
- Designed to capture ~15,000 tons per year of CO_2 at full capacity (1.7 MW)

ALSTOM

we energies

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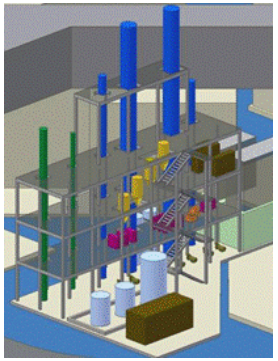
Courtesy of Alstom

Pulverized Coal with CCS at AEP

- *Description*
  - ~20-MW capture module at AEP's Mountaineer plant
  - Injection into on-site well and new second well



Pulverized Coal with CCS at Southern Company

- *Description*
  - ~25-MW capture module, using an "alternate post-combustion capture process"
  - Injection and storage test through DOE "SECARB"

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Clean Coal- Demonstration Projects

IGCC with CCS

- *Description*
  - Project 1 – existing unit with 10-20% CCS
  - Project 2 – existing or new unit with 40-60% CCS
  - Project 3 – new unit with 80-90% CCS
- *Participants*
  - Potential host sites identified for each project

Ion Transport Membrane O_2 Production

- *Description*
  - Pre-commercial demo of 150 ton-oxygen per day unit integrated with ~15 MWe system
- *Participants*
  - Air Products will lead and direct the project with Siemens and Ceramatec
  - DOE NETL is providing 80% funding

AIR PRODUCTS

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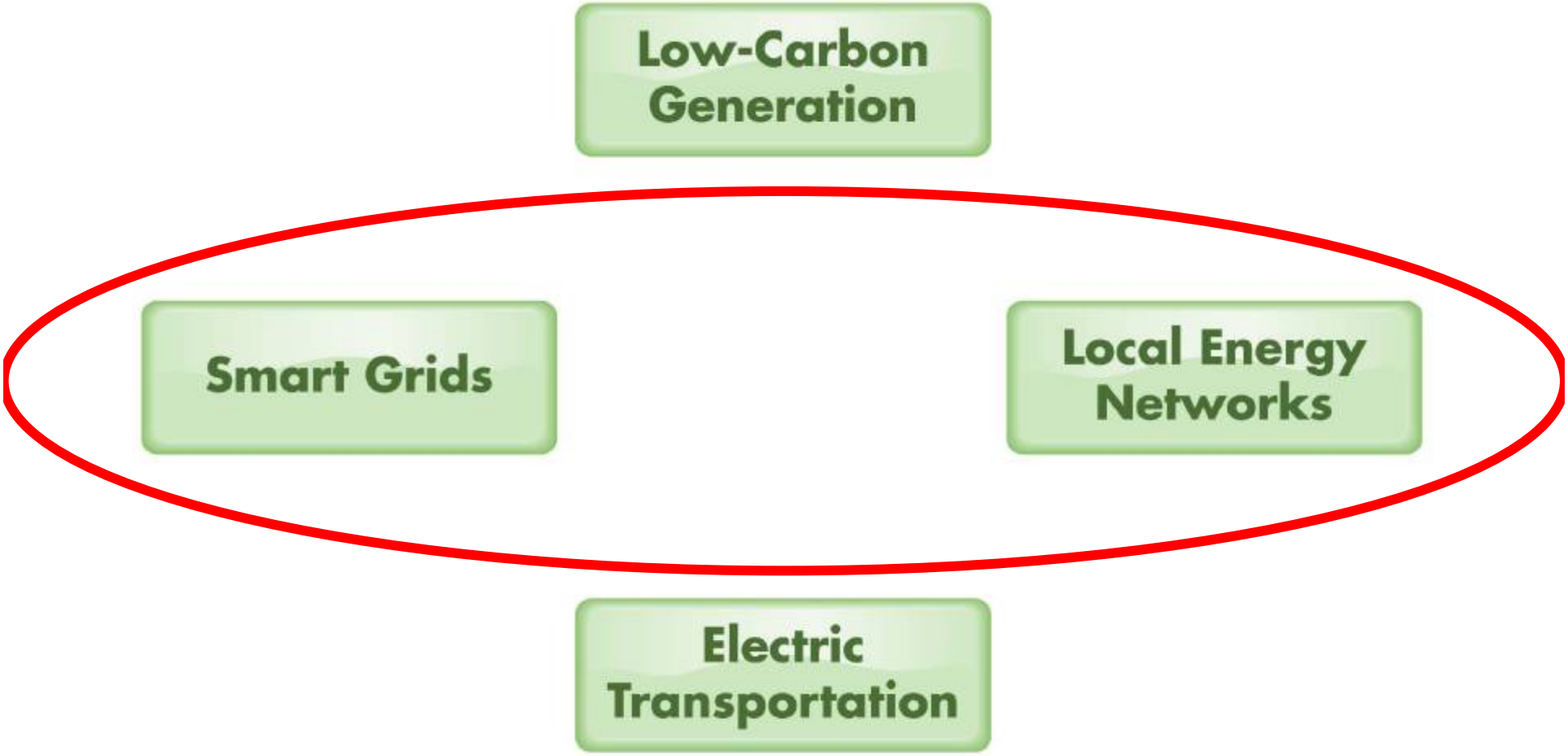
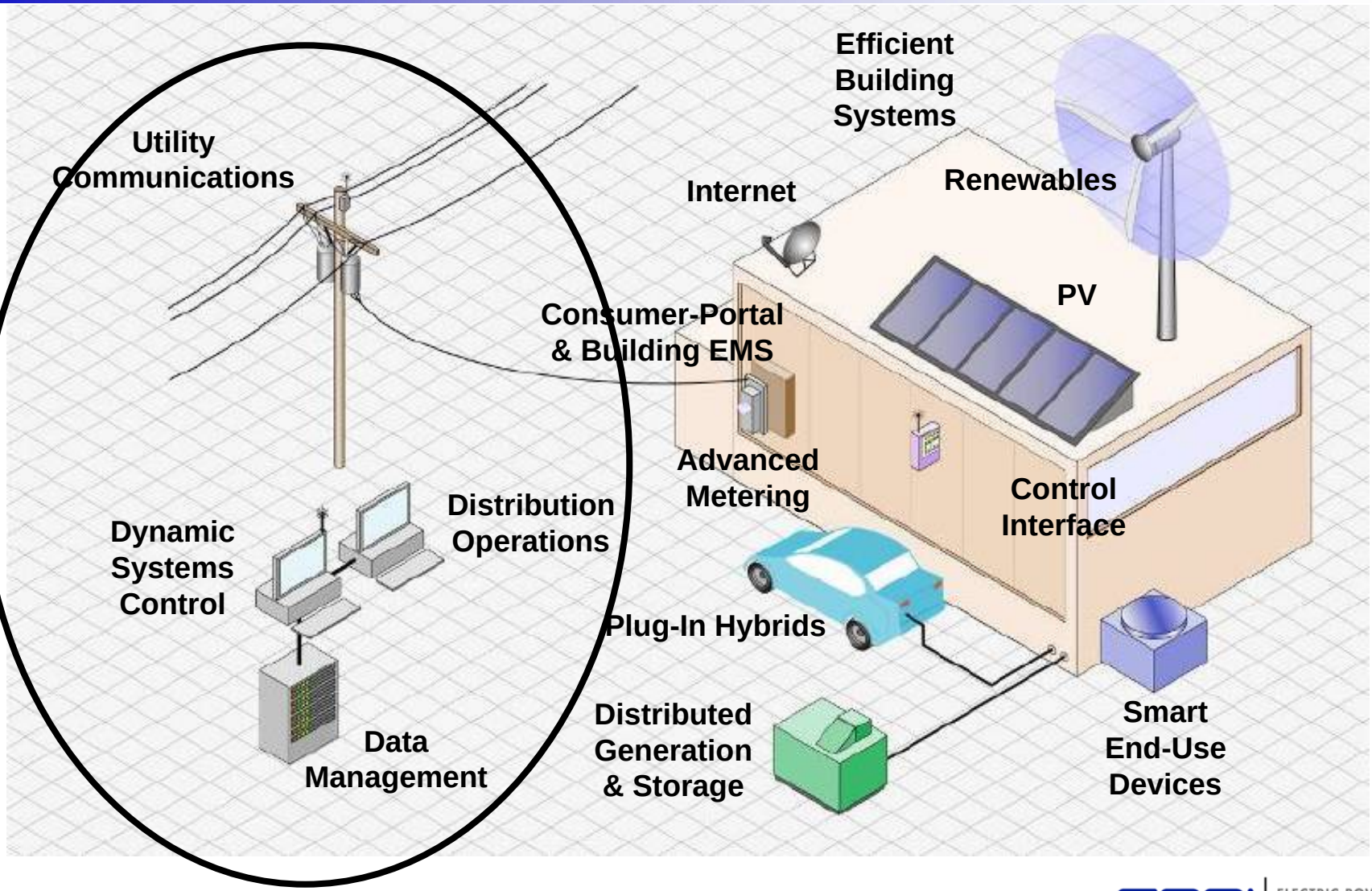
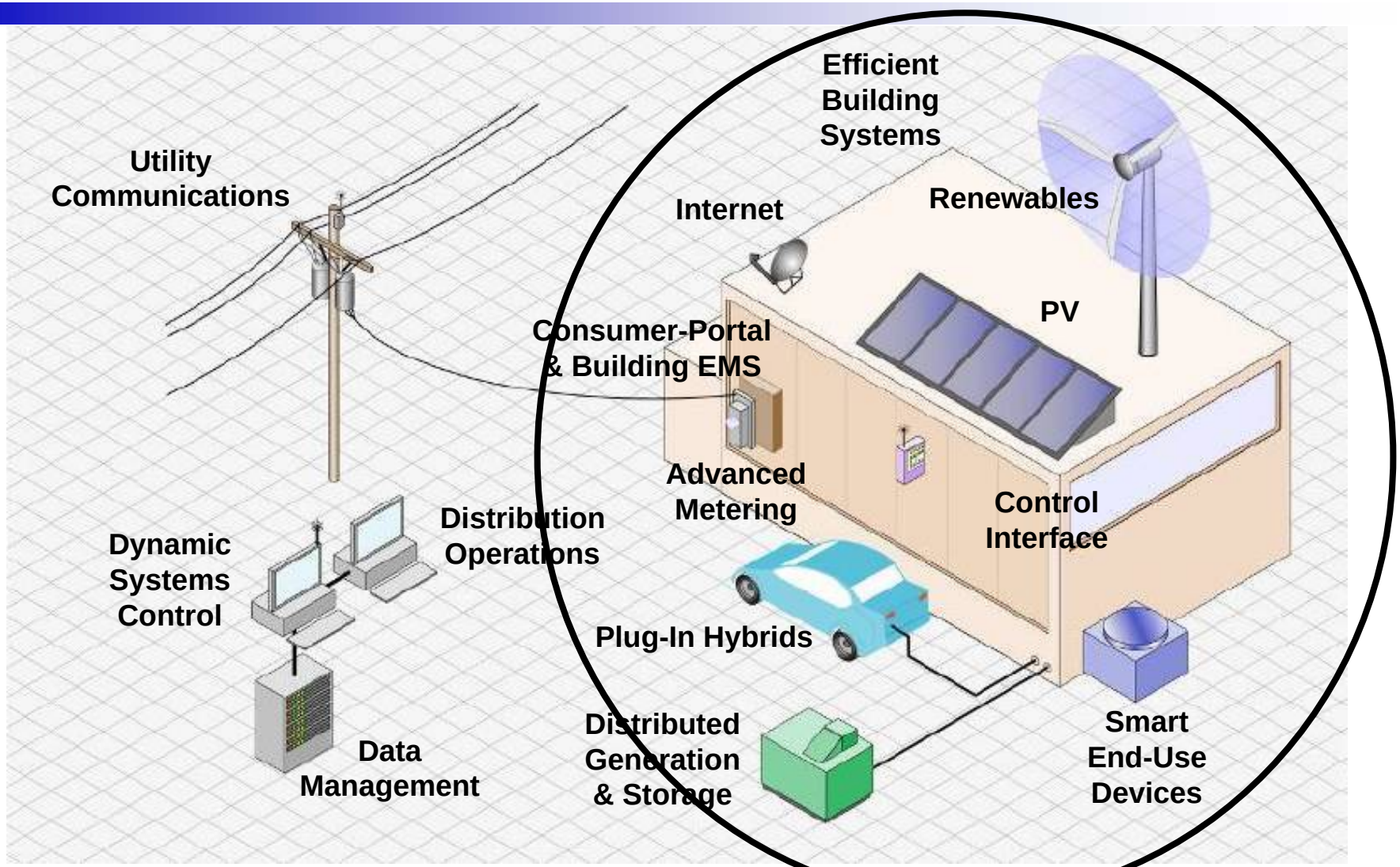


Smart Grids and Local Energy Networks



Smart Grids and **Local Energy Networks**



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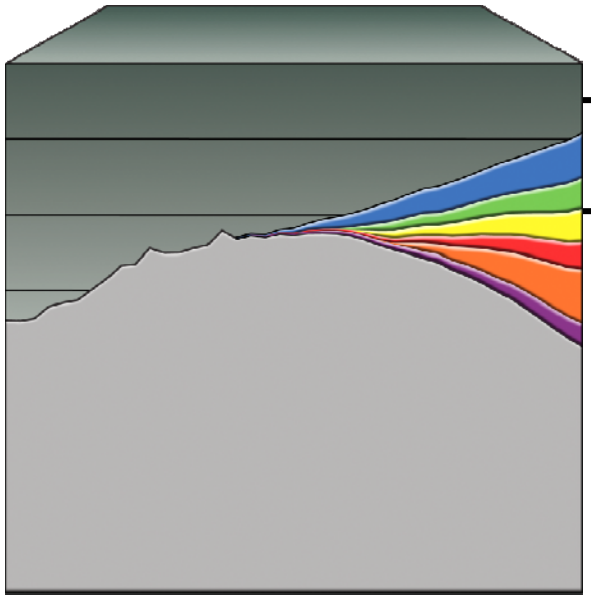
Industry Demonstration Projects… From Analysis to Action



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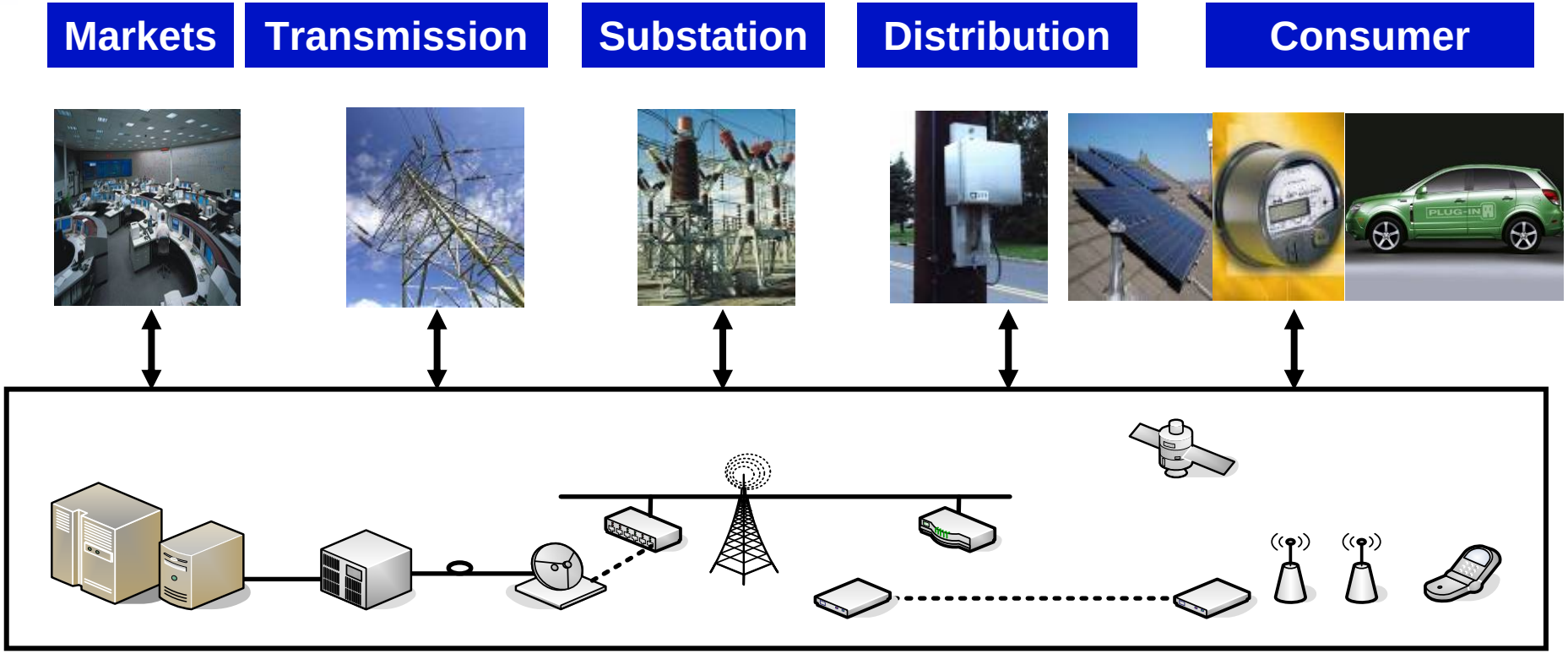
Smart Grid Demonstration Project



Interactive…Two-Way Communications

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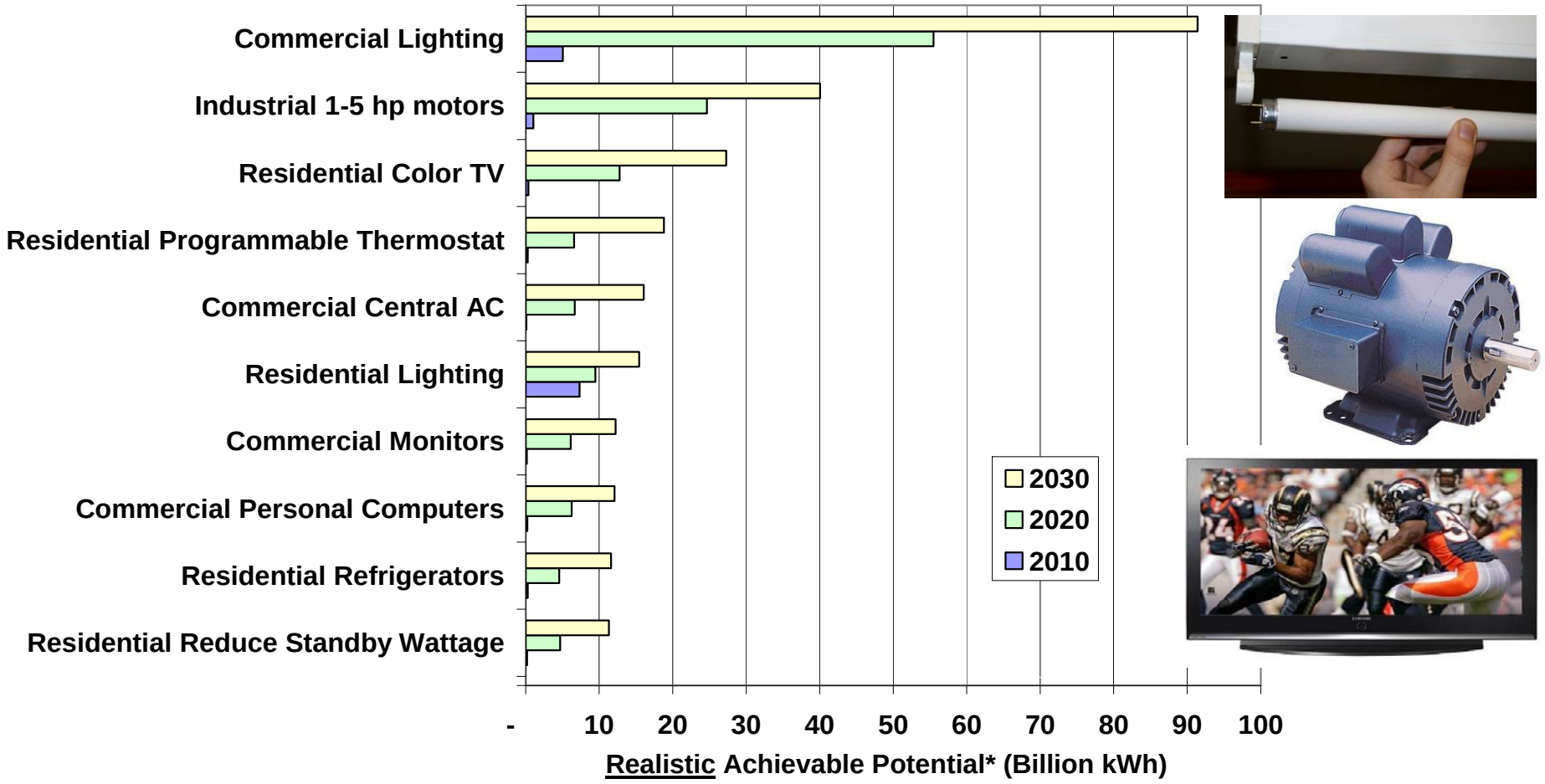
Opportunities for Energy Efficiency Savings

Top 10 Energy Efficiency Opportunities…



* Savings reflect total EE program savings potential, inclusive of savings implicit in AEO 2008

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Energy Efficiency Demonstration Project

High-profile field demonstrations of six "hyper-efficient" technologies with significant energy savings potential

COMMERCIAL

Variable Refrigerant Flow Air Conditioning

Efficient Data Centers

LED Street and Area Lighting

RESIDENTIAL

Heat Pump Water Heaters

Ductless Residential Heat Pumps and Air Conditioners

Hyper-Efficient Residential Appliances

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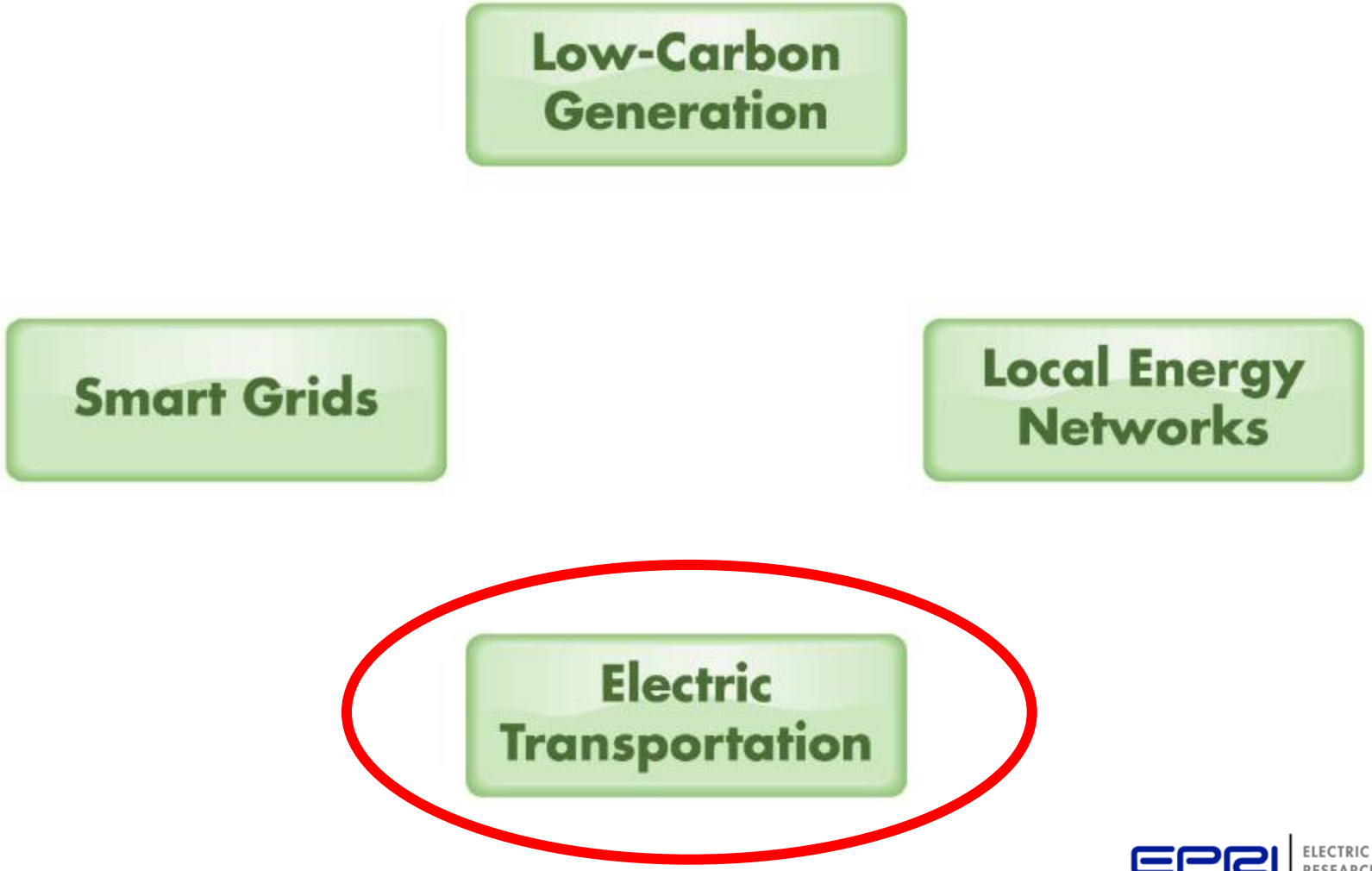
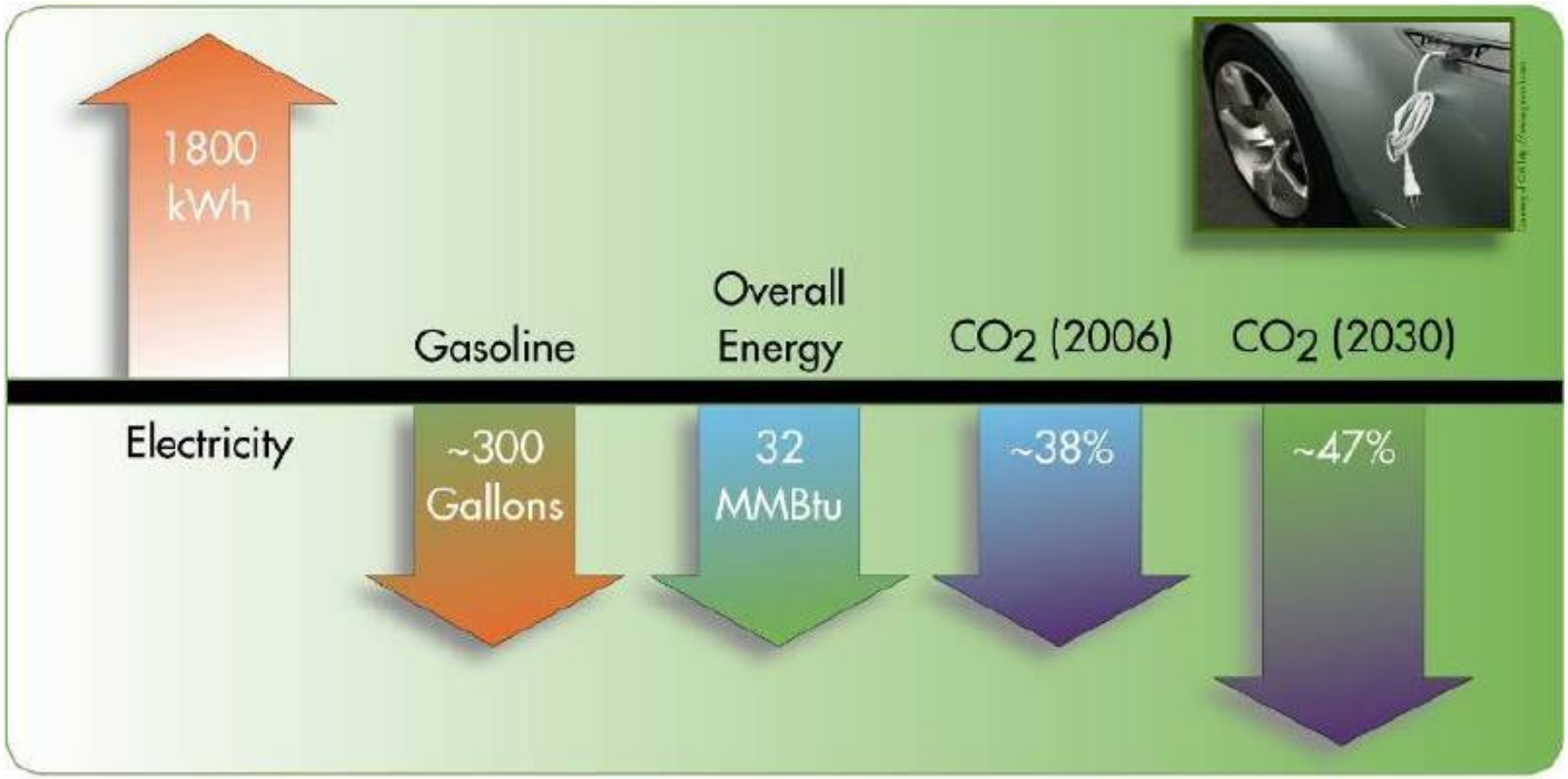


PHEVs (and EVs) Are Coming

	PHEV or EREV	EV
Production	 **Saturn VUE** 2-Mode Blended Intro: 2011 CY  **Chevrolet Volt** Extended Range EV 40-mile EV range 16kWh Li-Ion Intro: 2010 CY	 **Nissan** 2010 CY  **Daimler Smart ForTwo** 2010 CY  **Mitsubishi iMIEV** 2010 CY, 100 mile range, PG&E, SCE demo
Demo	 **Ford Escape PHEV** 2008 CY, 21 car fleet with SCE/EPRI/Utilities  **Ford/Eaton Trouble Truck** 10 truck fleet w/ utilities  **Toyota Prius PHEV** 500-car fleet 2009 CY  **VW Golf TwinDrive** 30 mile EV range 20-car fleet, 2009	 **Dodge ZEO** 150-200 mile range  **Subaru R1e** 50 Mile AER 10-car fleet 2008 CY

Benefits of 20 Mile Range PHEV



Energy Security…Energy Efficiency…Reduced CO_2

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Implementing a Low-Carbon Infrastructure

The Electricity Network of the Future

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together...shaping the future of electricity
Electricity…A Key Part of the Solution
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