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Aging Workforce – Overcoming the Technical Talent Challenge: What Skills Will Be Required?

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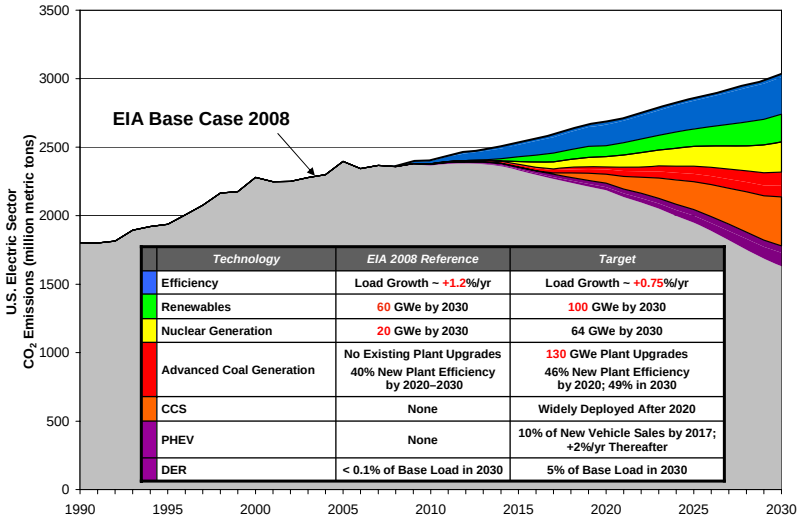
Vice President – Technology
April 22, 2008

CO_2 Reduction – Technical Potential U.S. Electric Sector (2008 EIA Baseline)



Technology	EIA 2008 Reference	Target
Efficiency	Load Growth ~ +1.2%/yr	Load Growth ~ +0.75%/yr
Renewables	60 GWe by 2030	100 GWe by 2030
Nuclear Generation	20 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Existing Plant Upgrades 40% New Plant Efficiency by 2020–2030	130 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

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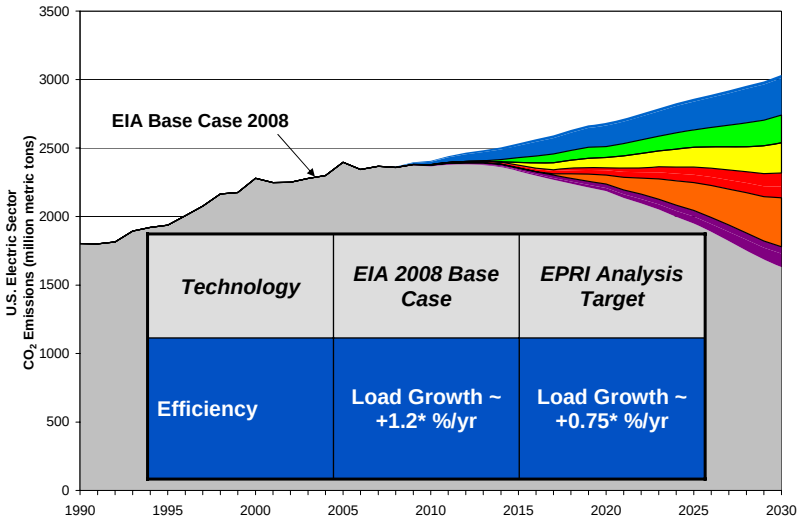
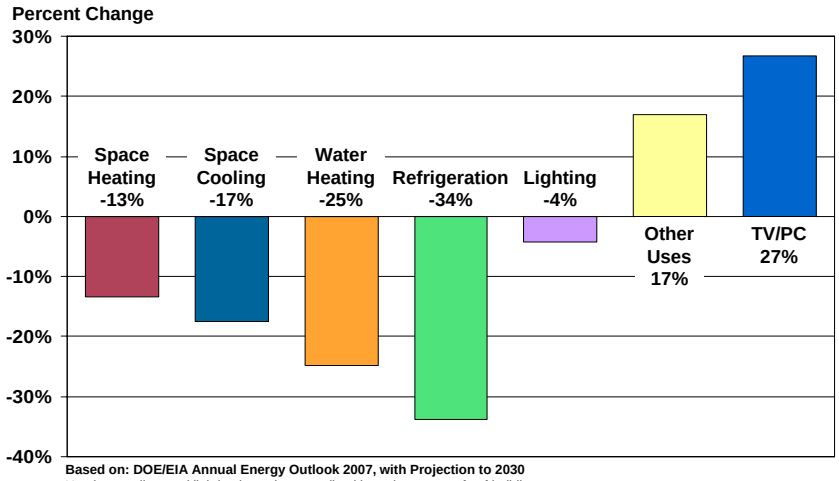
Energy Efficiency

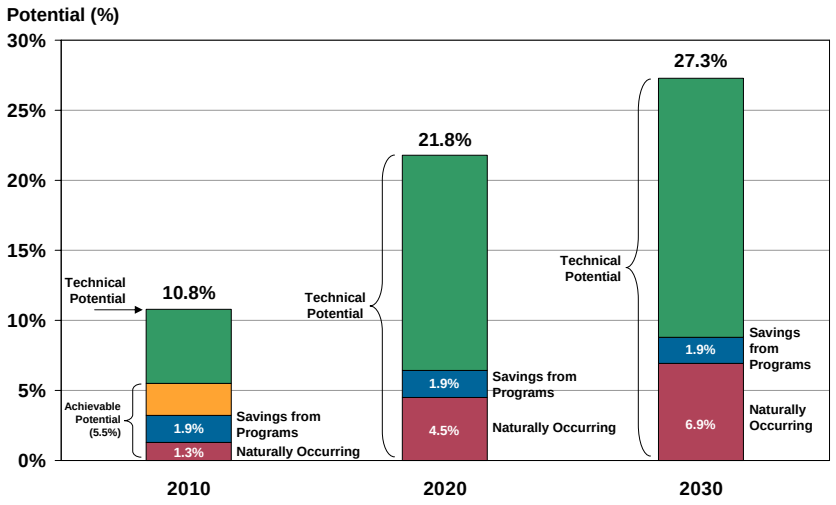


Estimated Change (from 2005 to 2030) in Electricity Intensity of Major Residential End Uses

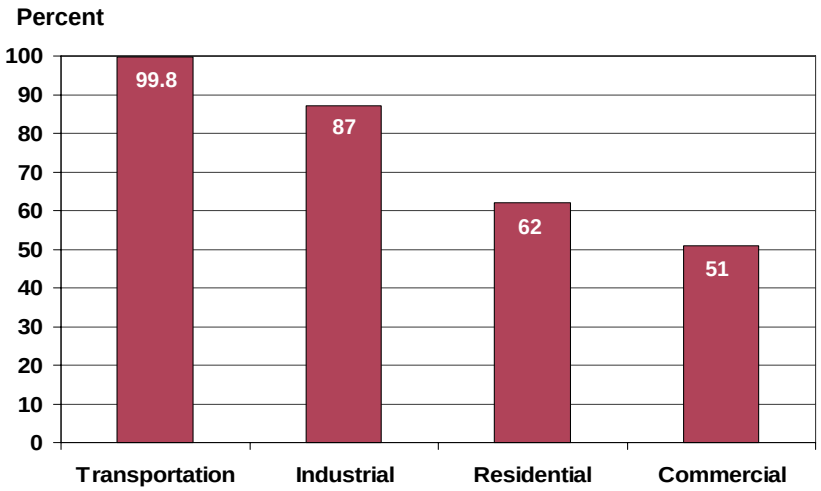


Based on: DOE/EIA Annual Energy Outlook 2007, with Projection to 2030
Heating, cooling, and lighting intensity normalized based on per sq. ft. of building space.
Refrigeration and TV/PC/set top/other uses normalized based on per household.

Energy Efficiency Potential Estimates

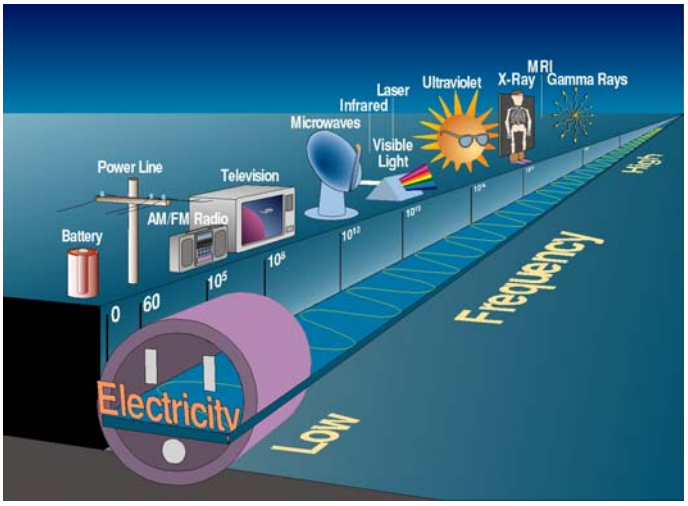


Potential for Electrotechnologies: Largest Use of Non-Electric Energy

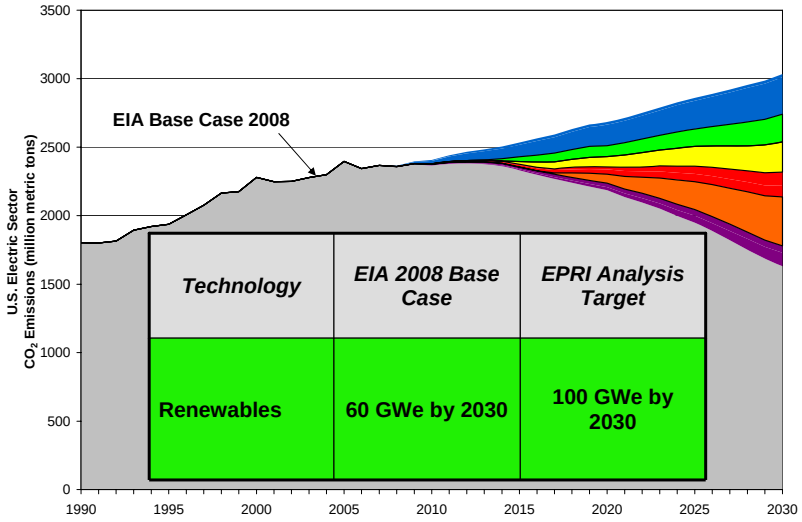


Source: DOE/EIA Annual Energy Outlook 2004.

Gateway to the Electromagnetic Spectrum



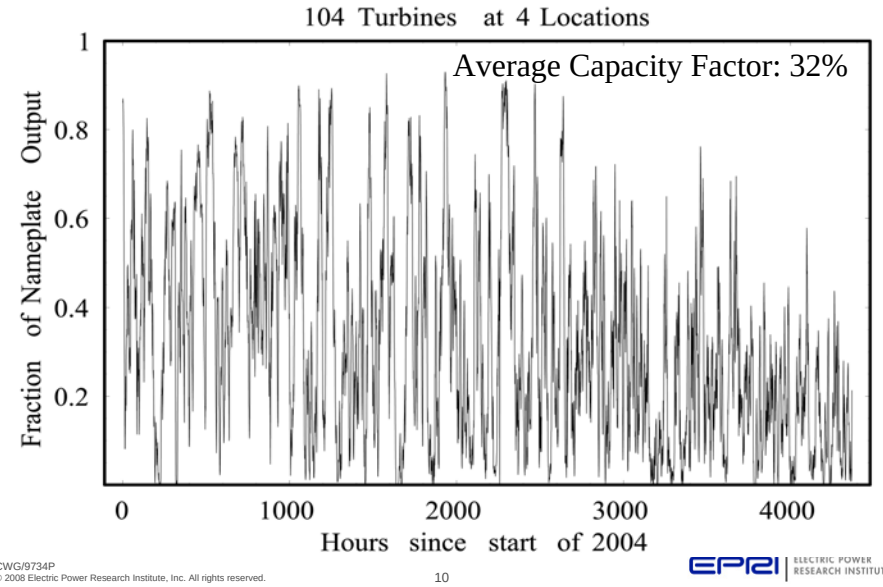
Renewable Energy



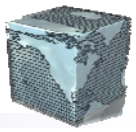
Renewables

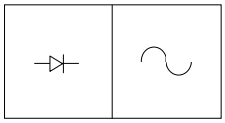
- Variability (intermittency) and integration issues remain; most critical in planning and operations
- Big opportunity in distributed PV – to DC and AC using power electronics

6 Months of Wind



Grid Interface – Technology Needs



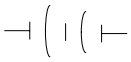


Inverters

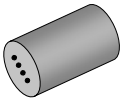
Direct DC (PV-DC)

Power Quality

T&D



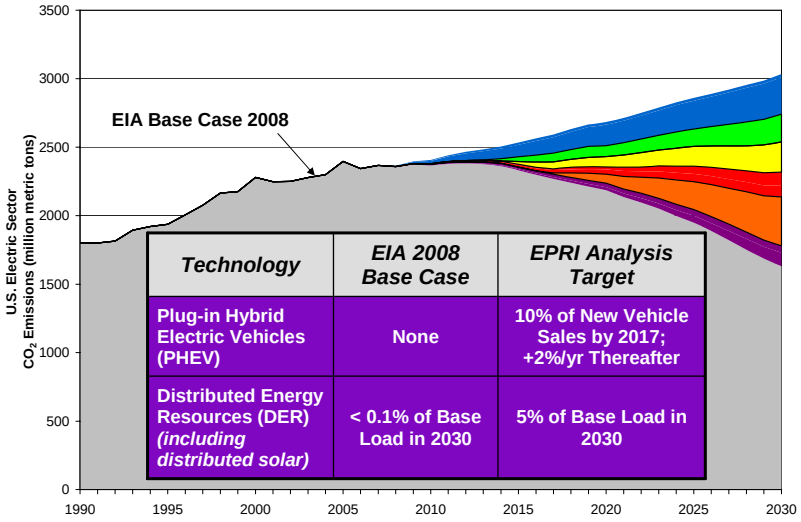
Storage



AMI Interface

- Technology development
- Dispatching
- Integration with grid and other technologies
- Intermittency
- T&D planning and operations
- Demonstration

Plug-In Hybrid Vehicles & Distributed Energy



Technology	*EIA 2008 Base Case*	*EPRI Analysis Target*
Plug-in Hybrid Electric Vehicles (PHEV)	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
Distributed Energy Resources (DER) *(including distributed solar)*	< 0.1% of Base Load in 2030	5% of Base Load in 2030

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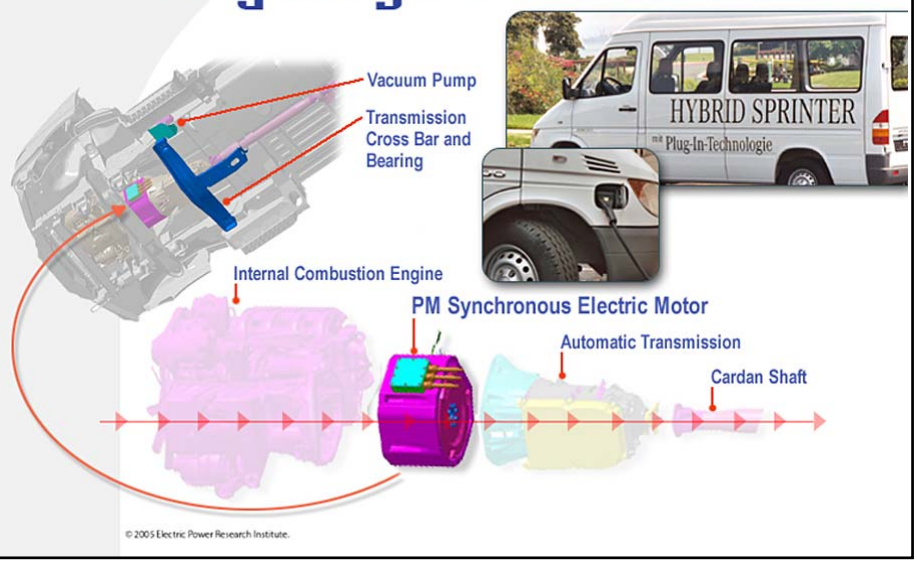
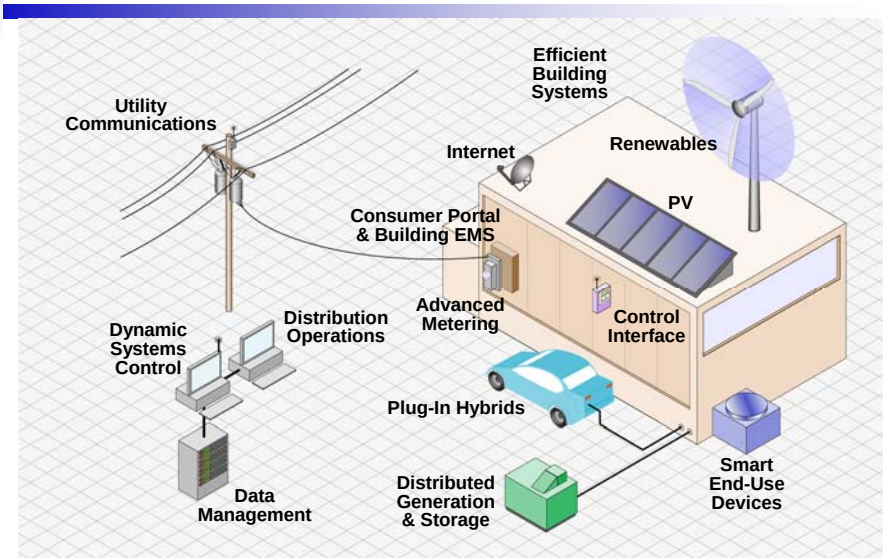
Plug-In Hybrid Power Train



Dynamic Systems Infrastructure: Consumer Opportunities



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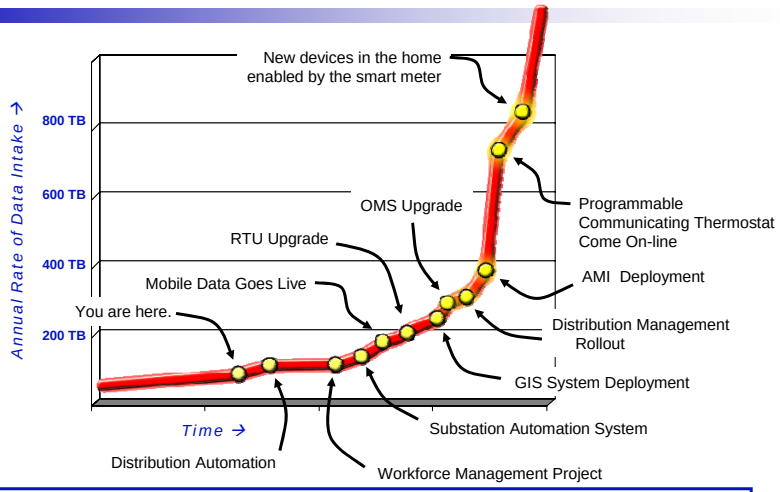
Smart Grid Field Data

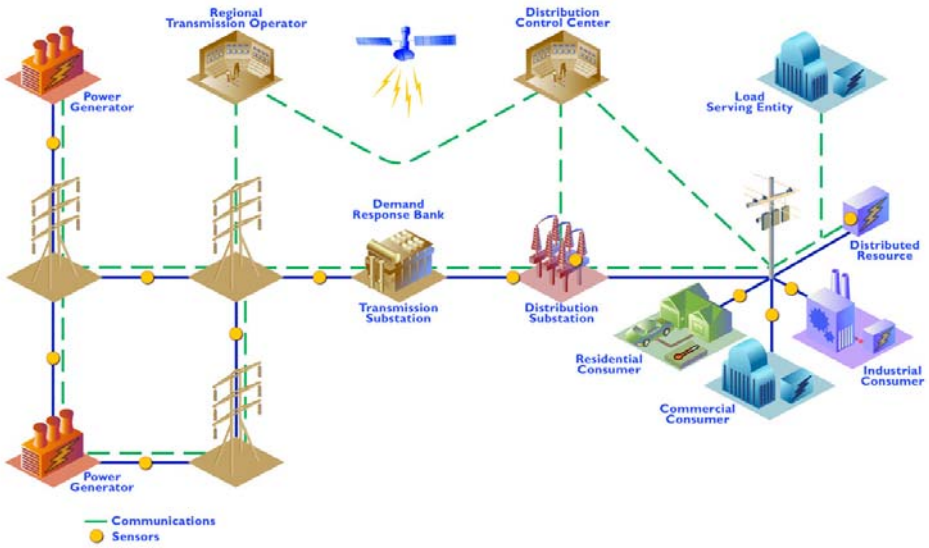


Tremendous amount of data coming from the field in the near future – paradigm shift for how utilities operate and maintain the grid

System Monitoring & Control

- Increased Use of Sensors
- Fast Simulation and Modeling
- Visualization
- Self Healing

Integrated Electric & Communications Systems



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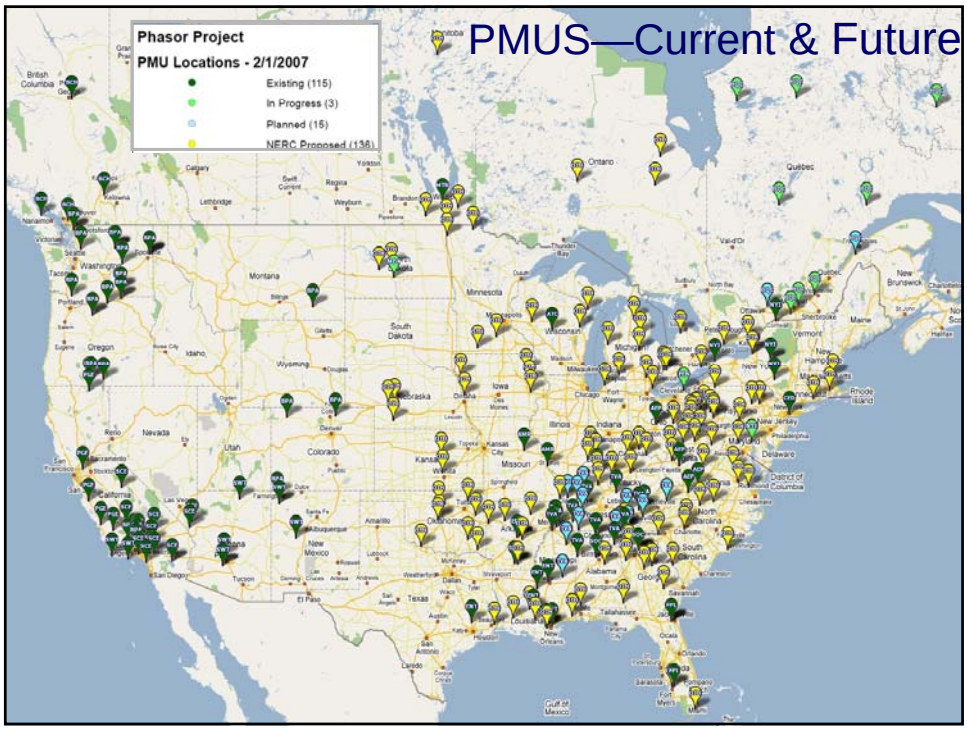
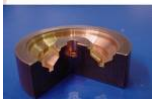
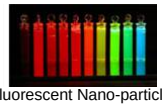
PMUS—Current & Future

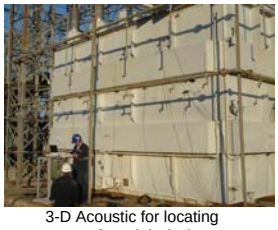


Widespread Use of Sensors

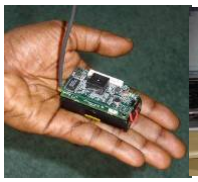




Fluorescent Nano-particle for Detecting LTC/OCB Contact Wear

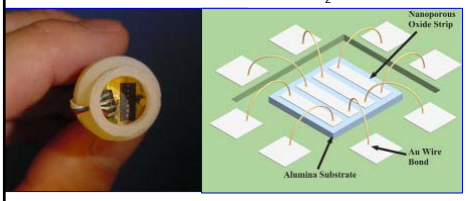


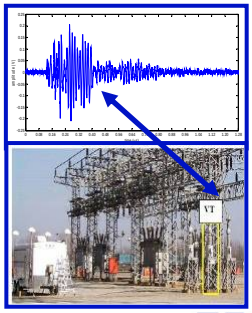
3-D Acoustic for locating source of Partial Discharge



Wireless Meshed Sensor Network

Metal Oxide Semiconductor Sensor for H_2 Gas Detection





Substation Antenna Array for Partial Discharge Detection

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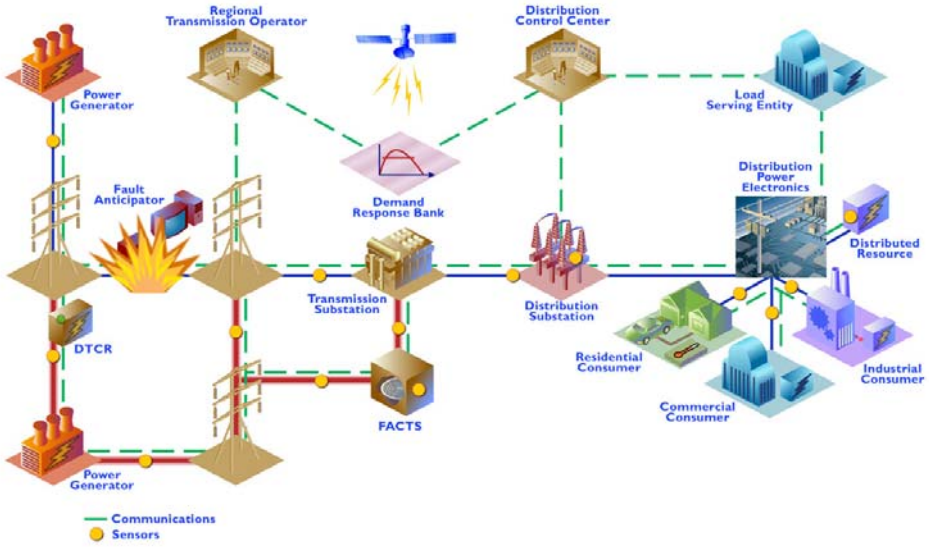
Enable A Fully Functional Power Delivery System



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