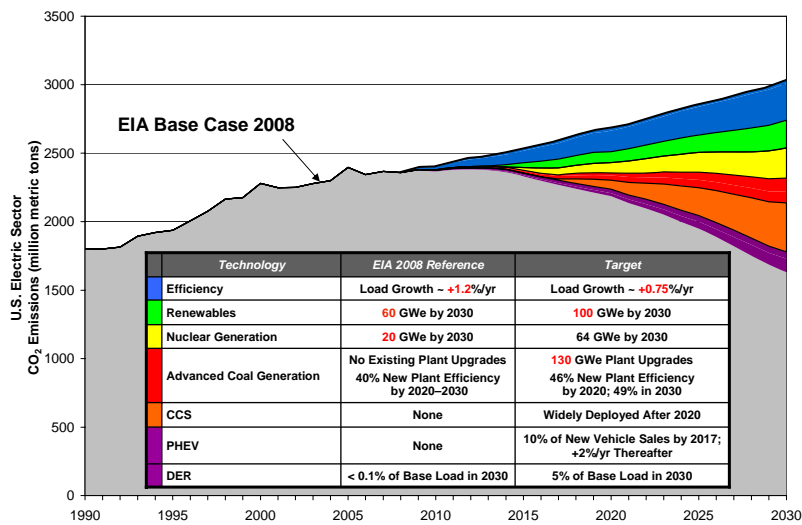




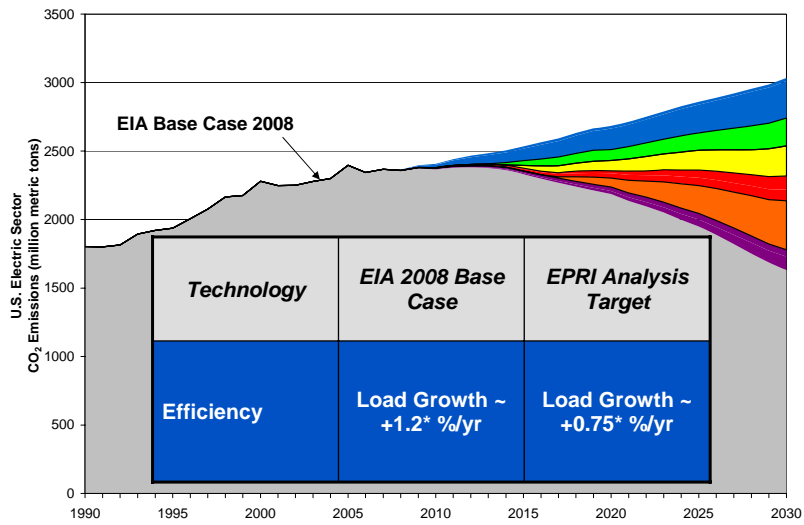
Aging Workforce – Overcoming the Technical Talent Challenge: What Skills Will Be Required?

Clark W. Gellings
Vice President – Technology
April 22, 2008

CO₂ Reduction – Technical Potential U.S. Electric Sector (2008 EIA Baseline)



Energy Efficiency

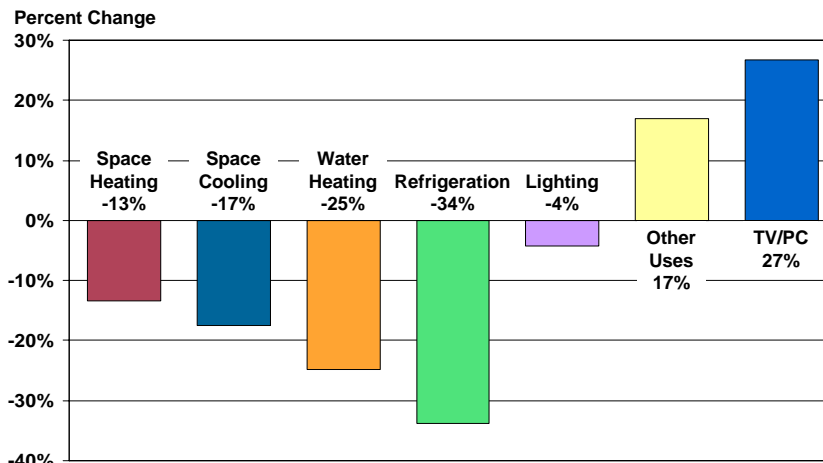


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Estimated Change (from 2005 to 2030) in Electricity Intensity of Major Residential End Uses



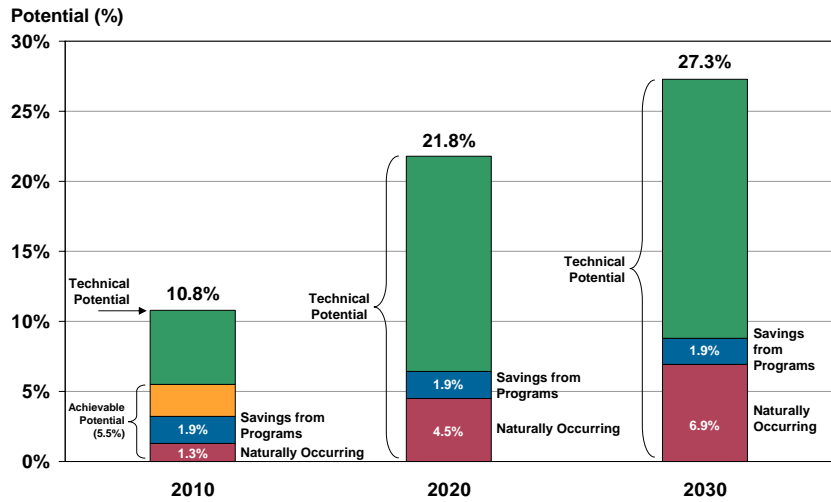
Based on: DOE/EIA Annual Energy Outlook 2007, with Projection to 2030
Heating, cooling, and lighting intensity normalized based on per sq. ft. of building space.
Refrigeration and TV/PC/set top/other uses normalized based on per household.

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Energy Efficiency Potential Estimates

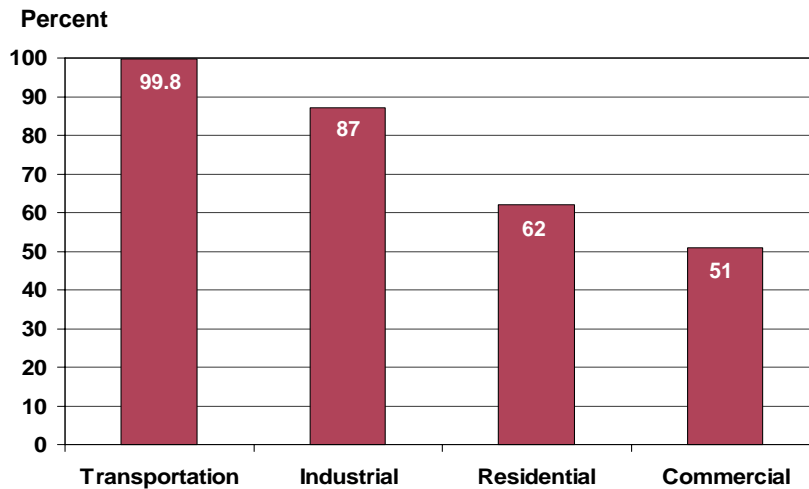


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Potential for Electrotechnologies: Largest Use of Non-Electric Energy



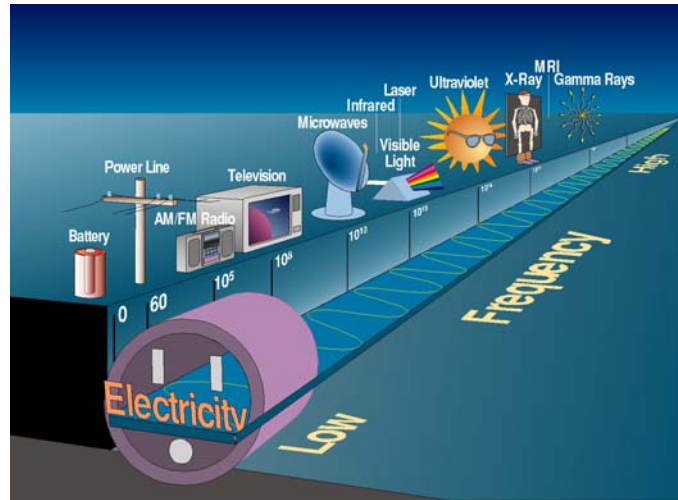
Source: DOE/EIA Annual Energy Outlook 2004.

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Gateway to the Electromagnetic Spectrum

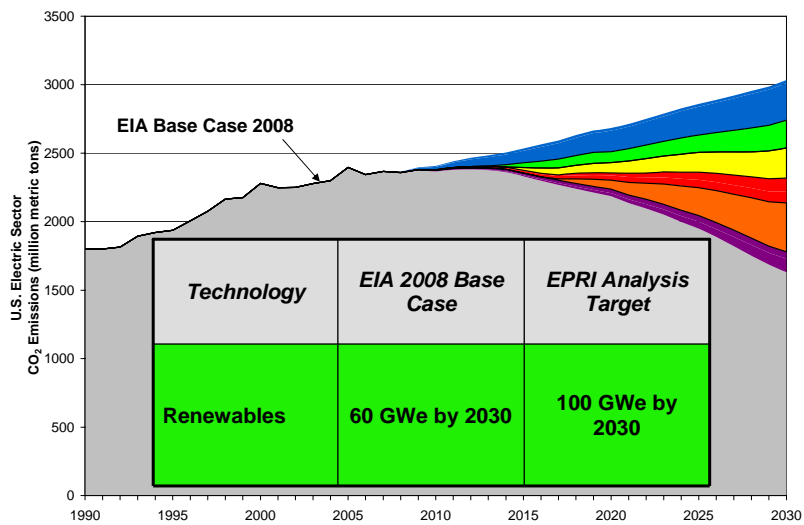


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Renewable Energy



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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

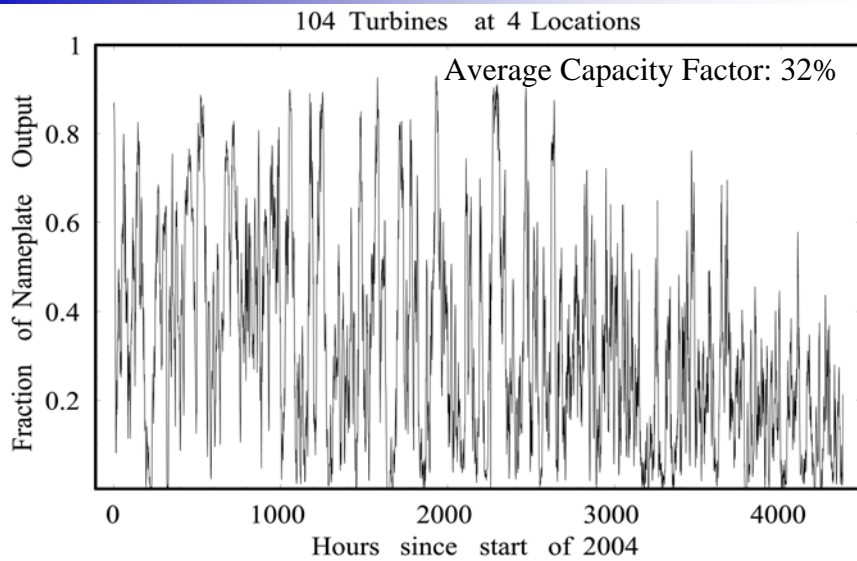


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6 Months of Wind

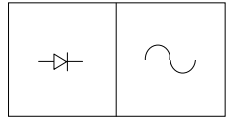
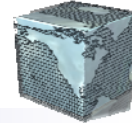


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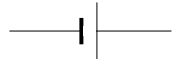
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Grid Interface – Technology Needs



Inverters



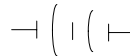
Direct DC (PV-DC)



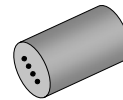
Power Quality



T&D



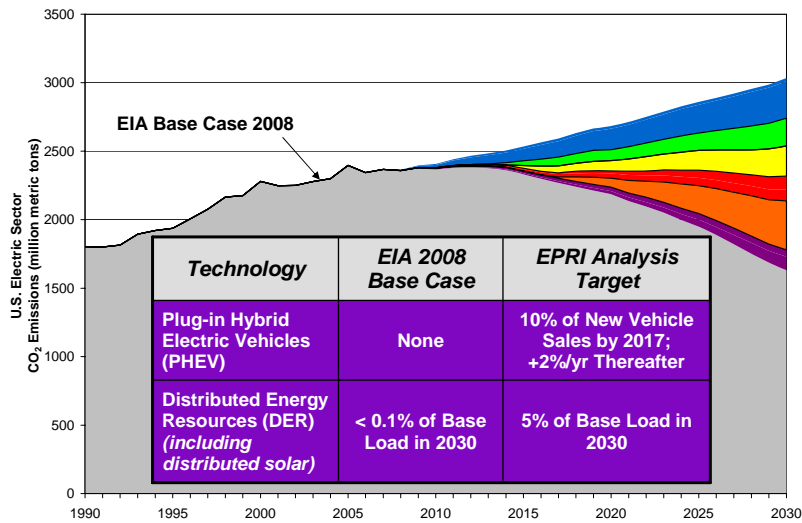
Storage



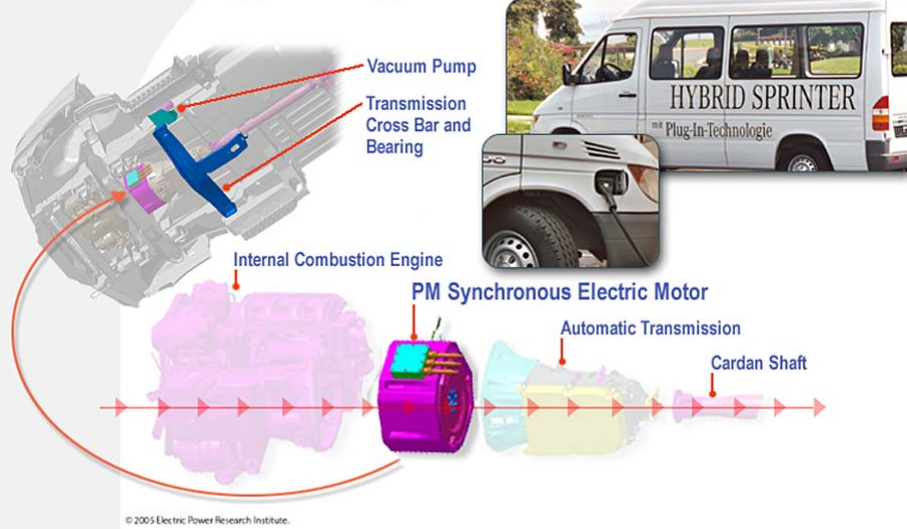
AMI Interface

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

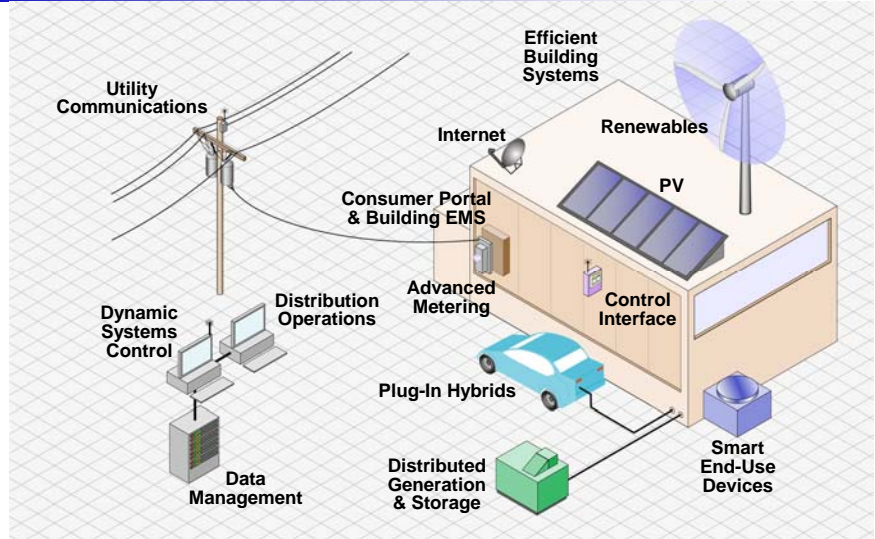
Plug-In Hybrid Vehicles & Distributed Energy



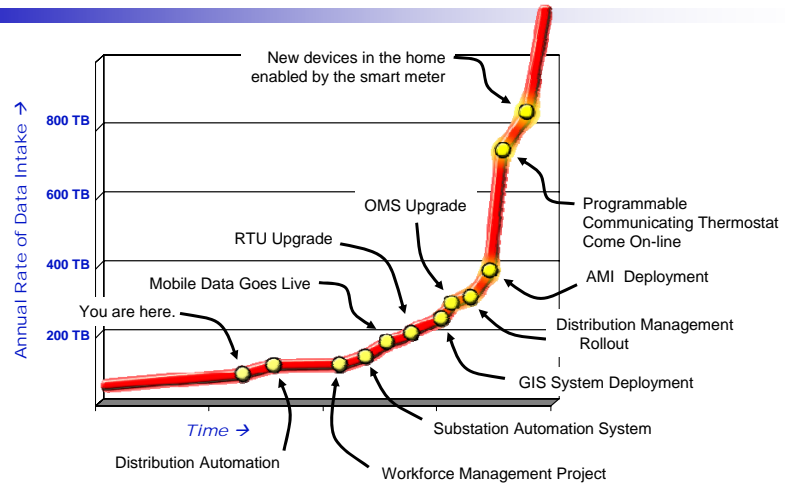
Plug-In Hybrid Power Train



Dynamic Systems Infrastructure: Consumer Opportunities



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

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System Monitoring & Control



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

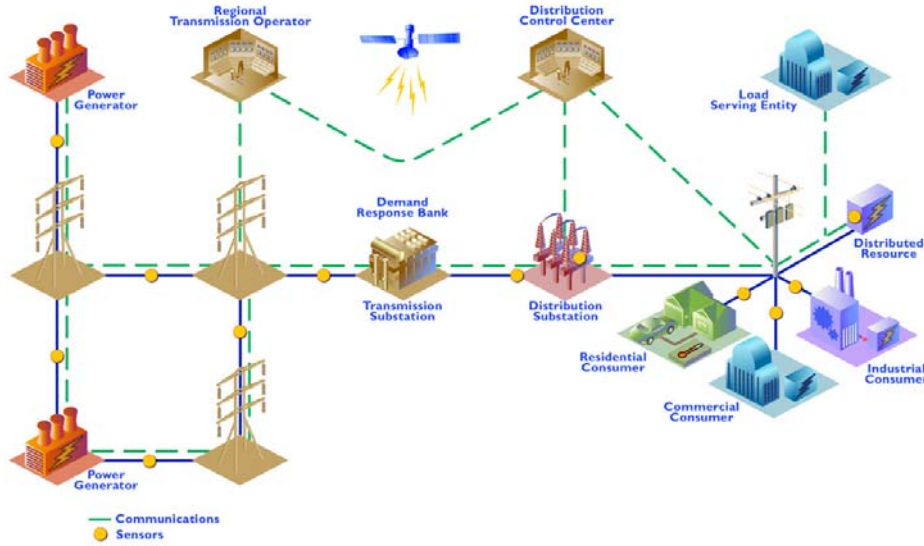


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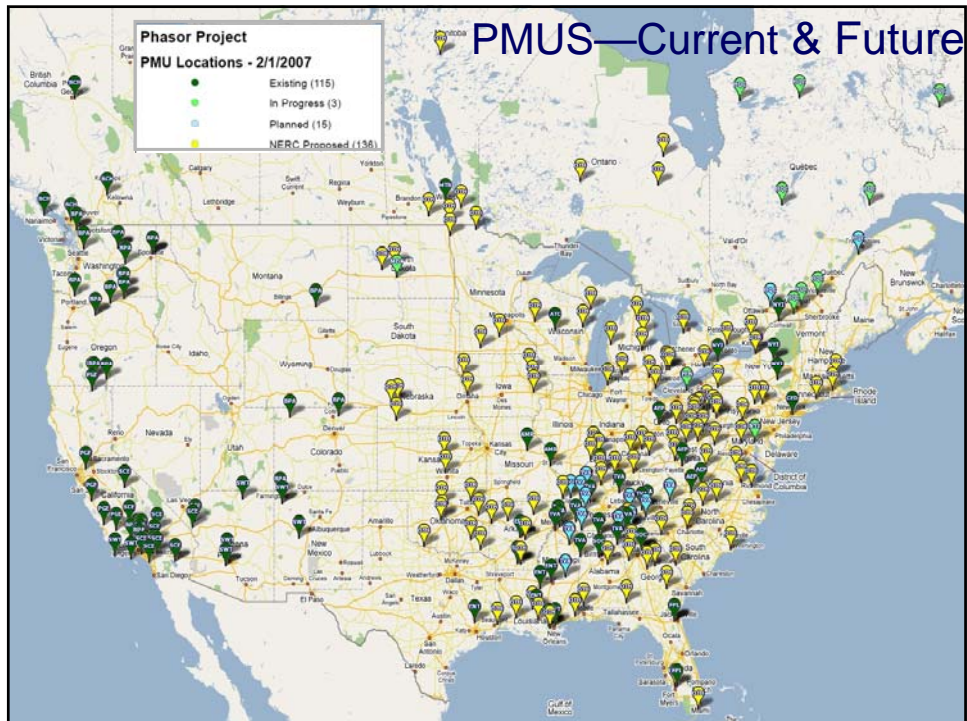
Integrated Electric & Communications Systems



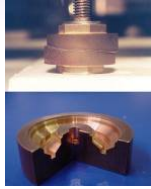
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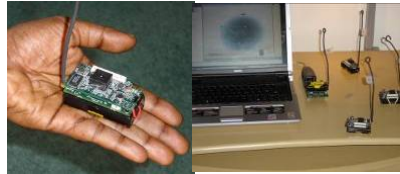
Widespread Use of Sensors



Fluorescent Nano-particle for Detecting LTC/OCB Contact Wear



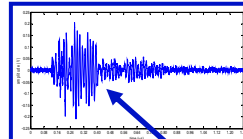
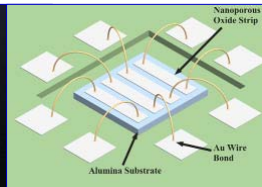
3-D Acoustic for locating source of Partial Discharge



Wireless Meshed Sensor Network



Metal Oxide Semiconductor Sensor for H₂ Gas Detection



Substation Antenna Array for Partial Discharge Detection

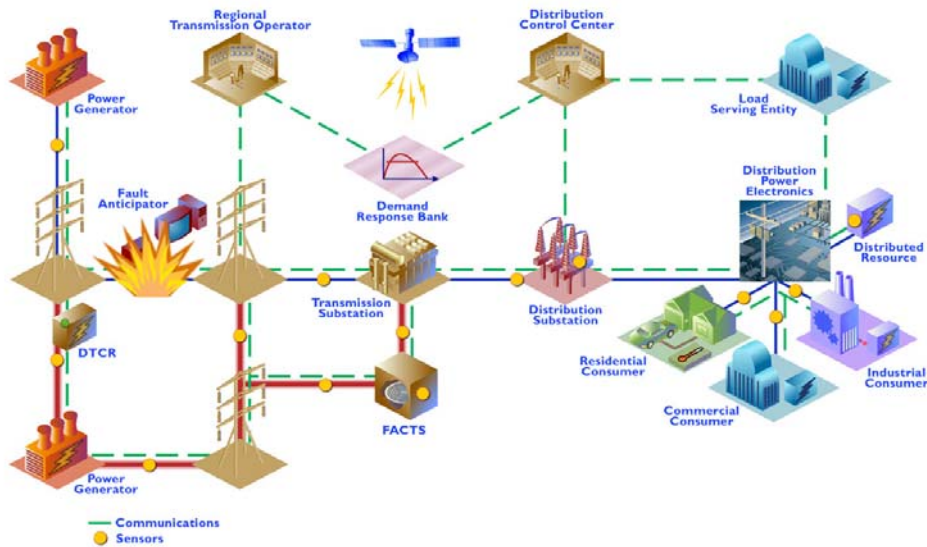


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Enable A Fully Functional Power Delivery System



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