



Identifying Emerging Smart Grid Impacts to Upstream and Midstream Natural Gas Operations

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.



What is the Smart Grid?

- Definition from IEEE:

“The Smart Grid has come to describe a next-generation electrical power system that is typified by the increased use of communications and information technology in the generation, delivery and consumption of electrical energy.”

- An integrated role of information in the delivery and availability of energy.

What is the Smart Grid?

The Smart Grid Can Deliver

BENEFITS

- Enhanced energy security
- Reduced greenhouse gases
- Improved urban air quality
- Increased grid asset utilization

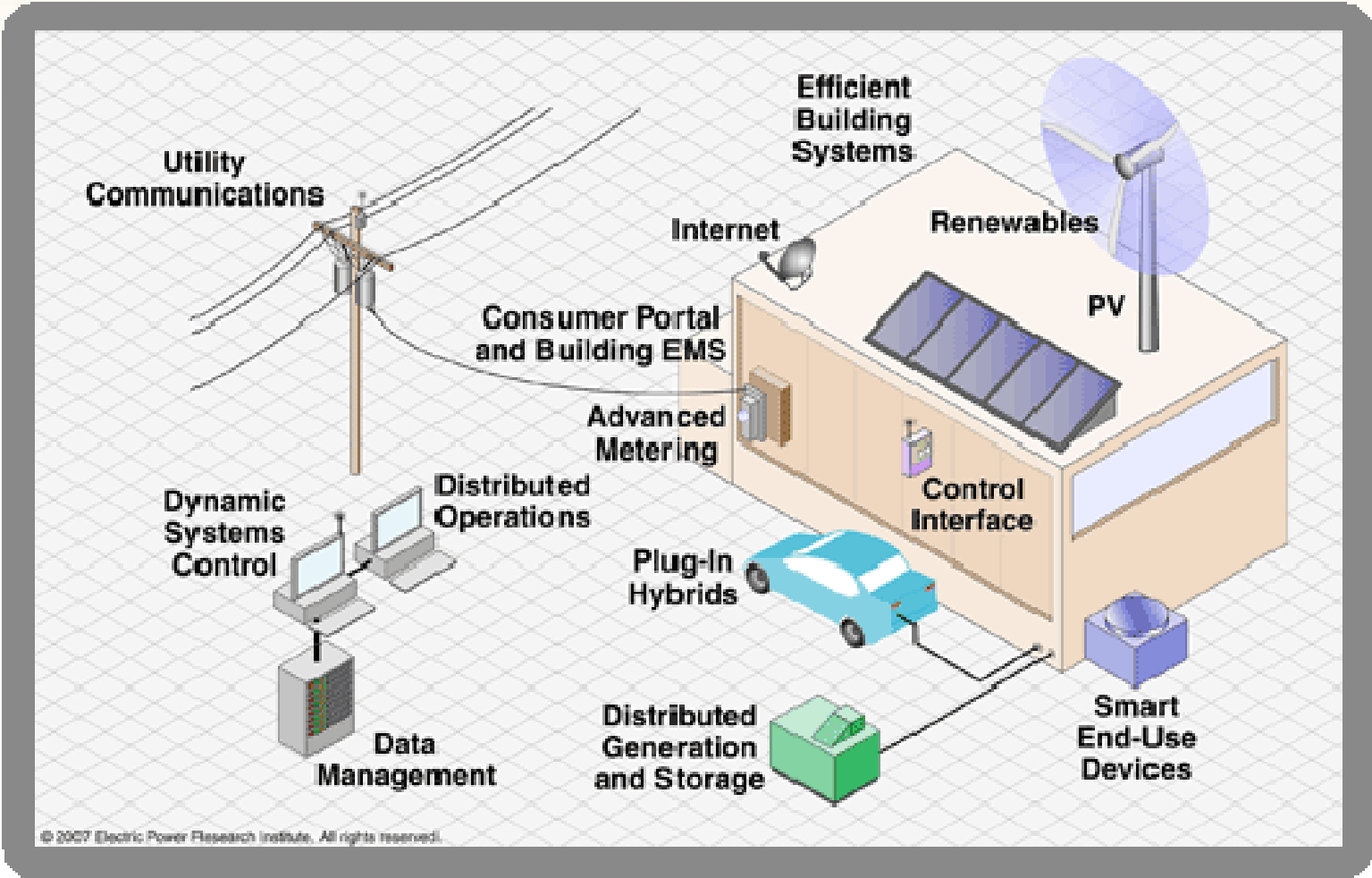
"Valley Filing" (Energy for PHEVs)

Graph showing energy usage for PHEVs over a 24-hour period. The x-axis is labeled "Hours of Day" with markers at 12, 18, and 24. The y-axis represents energy usage. A line graph shows a peak in energy usage during the day, corresponding to the PHEV's operation.

Category	Value
CO ₂ Emissions	1000 lbs
Urban Emissions	1000 lbs
Electric Sales	1000 kWh
Market Requirements	1000 kWh
Utility Rate	1000 kWh

US DOE OE

What is the Smart Grid?



EPR

Background

- Much of the present Smart Grid analysis focuses on utility and consumer interaction. I.e. smart appliances, home automation systems, rate structures, consumer demand response, etc.



image courtesy of SMA Solar Technology AG

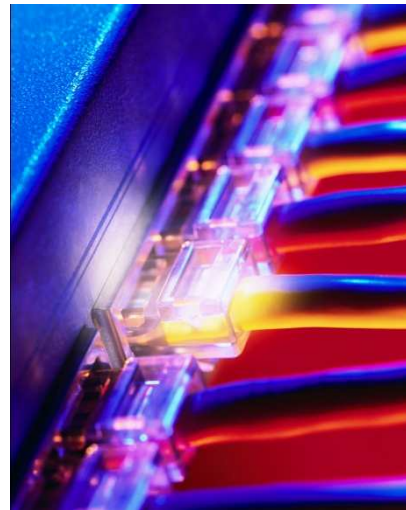


Background

- An Identified Need:
 - Assess the upstream and midstream operations of natural gas as a result of the smart grid
- The nature of Smart Grid, including the demand response and role of information, may require changes in upstream and midstream natural gas operations to ensure availability and efficiency.
- Utility reliance on natural gas will continue and likely increase, given the backup requirements for intermittent renewable energy sources.
- Efficient generation and delivery of electricity on Smart Grid could affect how natural gas is utilized.

Background

- Significant areas for analysis:
 - Operational demand and energy flow
 - Grid stability
 - Contractual and data concerns
 - Cyber security



What do we already know about Smart Grid?

- The role of information and data integrity is increasingly important.
- Smart Grid includes a fully distributed system with two-way communication.
- Smart Grid, a complex network, may change the way energy is supplied, stored, and in demand.
- Smart Grid has evolved through consumer driven decisions.
- Smart Grid and the US critical infrastructure will include many intermittent renewables.

What must be considered in upstream and midstream gas, and storage?

- Operational effects of Smart Grid on the flow and control of gas, as well as the role of storage
 - Demand response
 - Fluctuations
 - Technology changes
- The integration effects of small and large scale intermittent renewables and the role of fossil fuel.
- Commerce and contractual activities associated with the transport of gas.
 - Additional policies or changes required?
- The need to continue the stability and surety of the US energy infrastructure.



Factors in Analysis

- Operational units and logistics
- Regional effects and incentives
- Influences of consumer driven choices
- Impacts to pipelines
- Storage
- Technology
- Decisions in terms of safety and stability
- Existing contractual guidance
- Emerging standards, policies, and best practices
- Communication and industry engagement



Approach

- What is the federal role?
- Short term, long term impacts
- Establish a way to share information
- Analyze on-demand requirements
- Innovative ways to manage demand
- Conduct a logical-level analysis of the critical infrastructure
 - Flow of energy
 - Role of controls
 - Storage to maintain stability