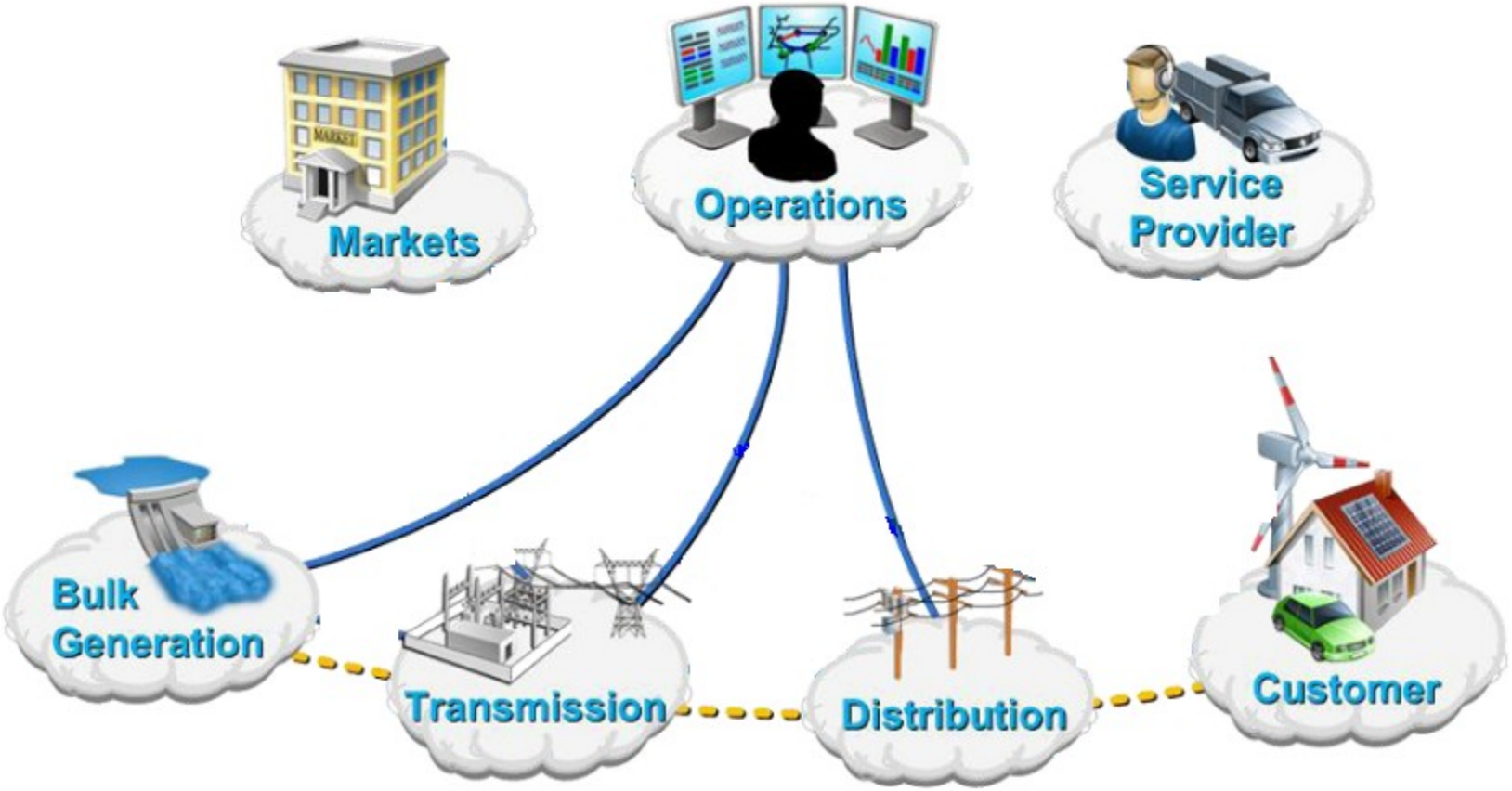
SMART GRID:

Dream or Nightmare ?

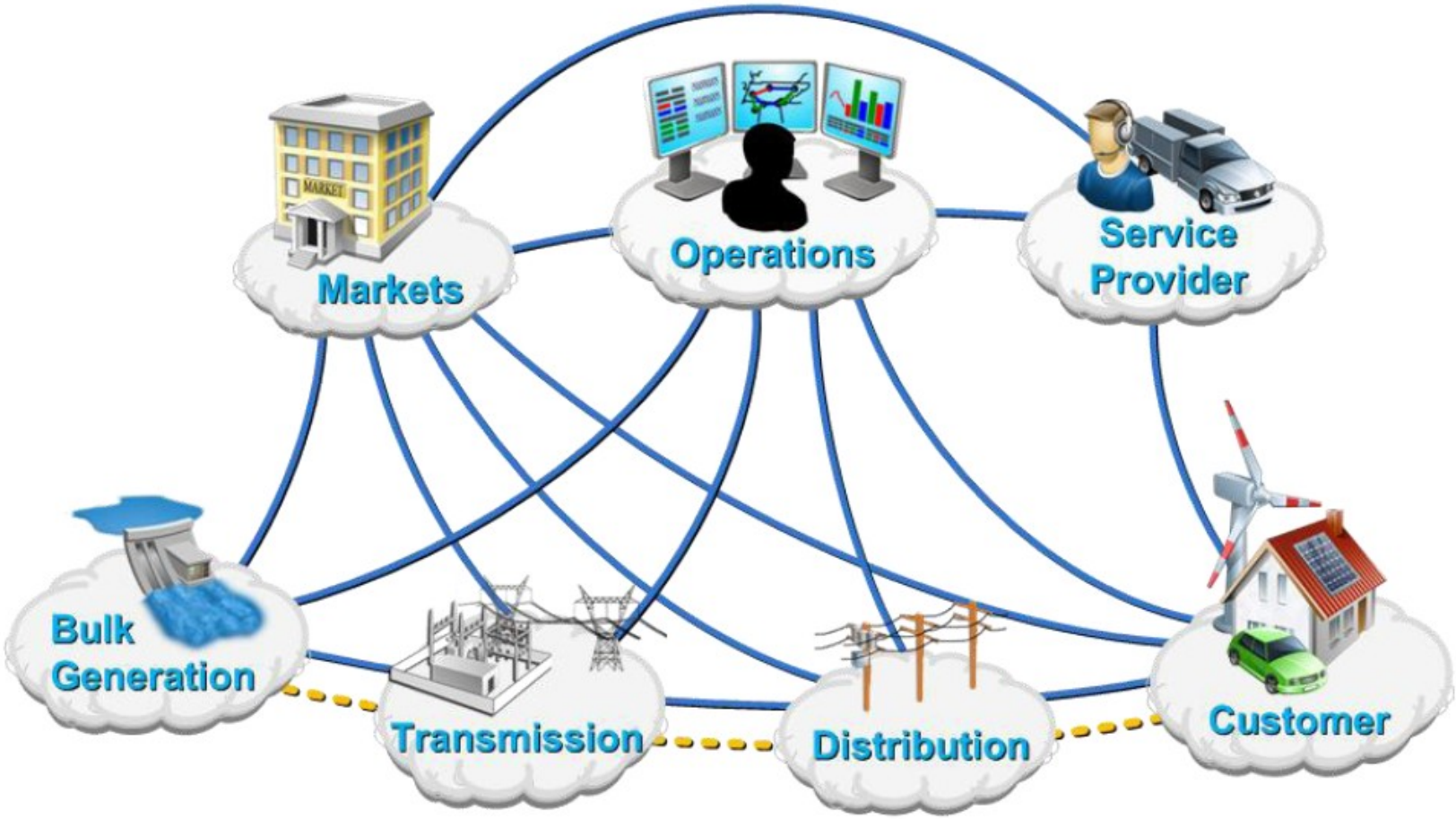
IP Kruger

Schneider Electric

Jurassic Grid



SMART GRID

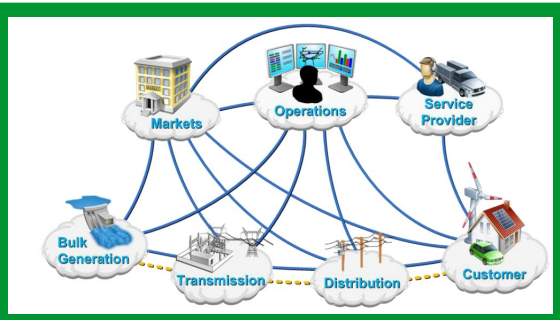

Markets
Operations
Service Provider
Bulk Generation
Transmission
Distribution
Customer

“Smart Grid” definitions

“Smart grid means many things to many people” – Cap Gemini

IEC SMB G3
has proposed draft definition and conceptual model
NIST model

Smart Grid is the concept of modernizing the electric grid.
The Smart Grid integrates the electrical and information technologies in between any point of Generation and any point of Consumption



T&D centric

Smart grids are modern power transmission and distribution systems that are capable of accepting power of any quality from any source and delivering it to consumers of all kinds via a bidirectional supply system…

Includes Power Generation & Building End Users

A Smart Grid is a power generation and distribution network based on two-way communication among all entities involved in the power market. … Another critical aspect of the Smart Grid system is that it allows end consumers to actively participate in the energy market and thus make a contribution to climate protection.

Quite selfish…

The smart grid is built on smart metering

IT centric

A new, more intelligent electric system, or ‘smart grid’ is required that combines IT with renewables energy to significantly improve how electricity is generated, delivered and consumed…

Google.
More consumer centric

XX and Google are joining forces to help develop tomorrow’s power generation, transmission and distribution — known as the “smart grid” — and its interface with next generation electric transportation.
Our goal is to provide consumers with improved and expanded energy choices, whether it’s buying renewable power, driving a plug-in car, or reducing energy bills by managing home energy use.

SMART GRID
Definitions

- **"automated, widely distributed energy delivery network characterized by a two-way flow of electricity and information, capable of monitoring and responding to changes in everything from power plants to customer preferences to individual appliances."**

- **"a smart grid is the electricity delivery system (from point of generation to point of consumption) integrated with communications and information technology"**

SMART GRID

- **As can be seen from the previous slides, a smart grid is a complex concept and to clearly define what it is, could be as complex.**

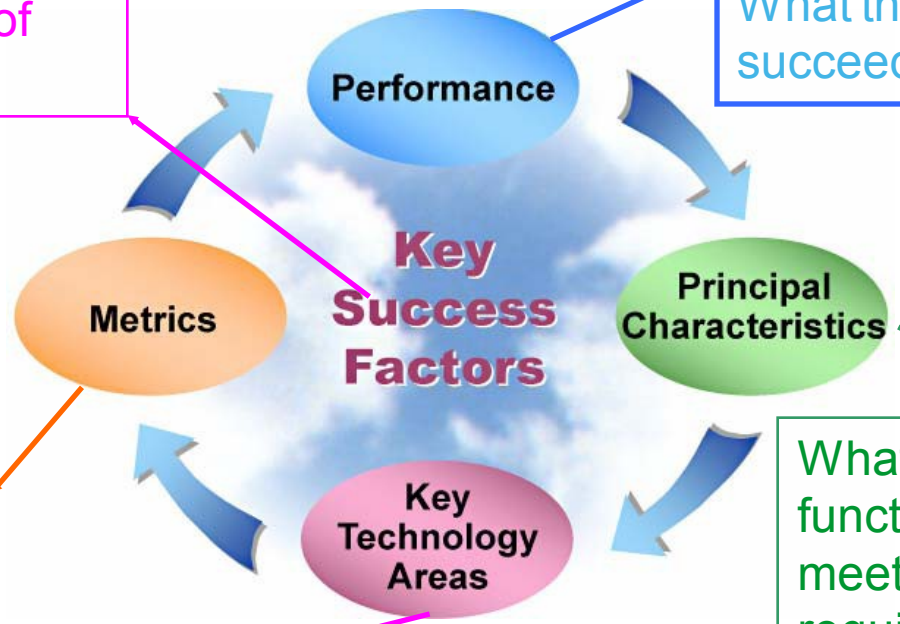
- **The USA Department of Energy, National Energy Technology Laboratory issued a document series on "A systems view of the modern grid" and the following presentation has been adapted from that document**

SMART GRID

The systems view defines the following elements of a smart grid.

The broad goals of the modern grid

What the grid must do to succeed

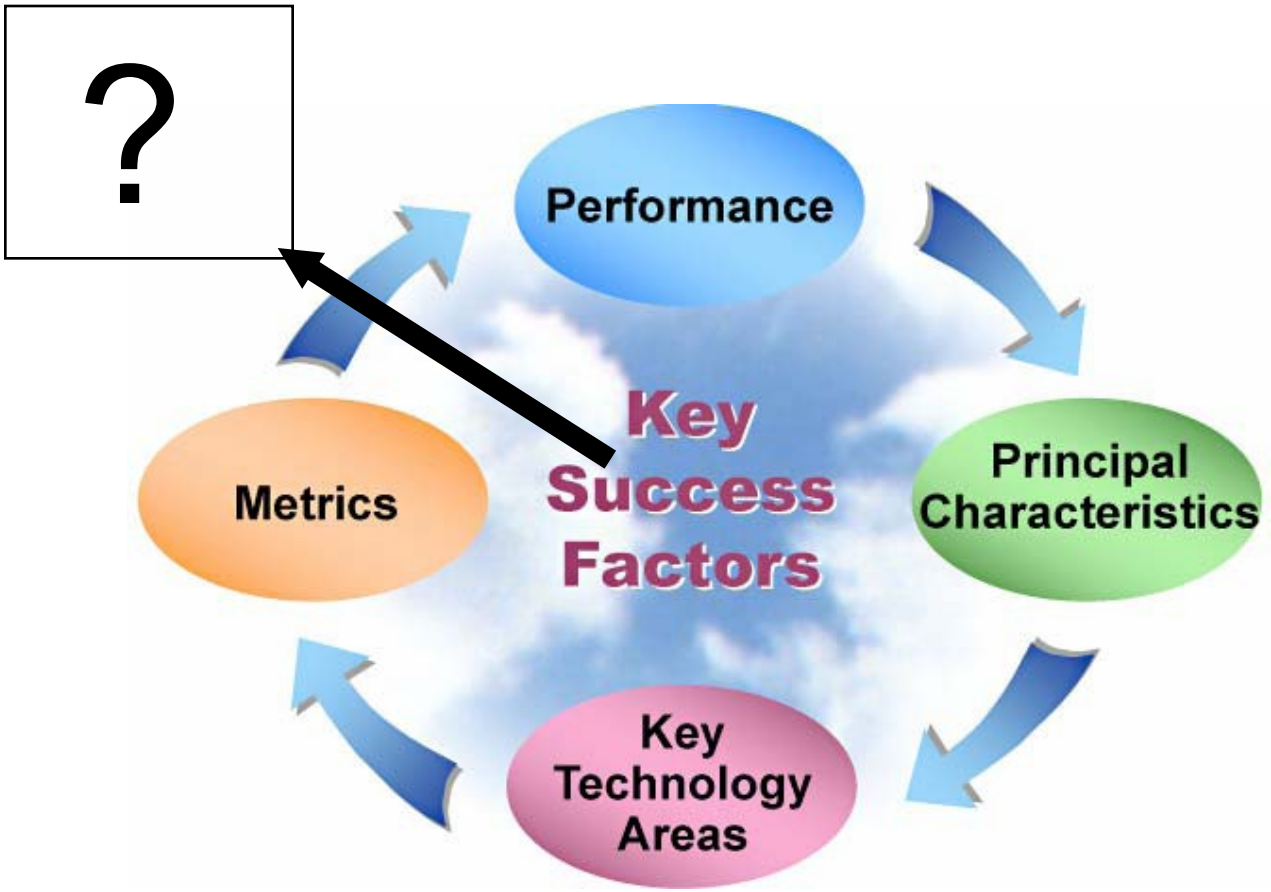


How progress is measured and compared to the desired level of performance, to ensure that the key success factors are ultimately achieved.

What features and functions are essential to meeting performance requirements

Which technologies support the desired characteristics

SMART GRID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Performance
Principal Characteristics
Key Technology Areas
Metrics
Key Success Factors

SMART GRID

The KEY SUCCESS FACTORS are:

- Reliable
- Secure
- Economic
- Efficient
- Environmentally friendly
- Safe

SMART GRID
Key Success Factors

Reliable

A reliable grid provides power dependably, when and where its users need it. It provides ample warning of growing problems and withstands most disturbances without failing. It takes corrective action before users are affected.

SMART GRID
Key Success Factors

Secure

A secure grid withstands physical and cyber attacks without suffering massive blackouts or exorbitant recovery costs. It is less vulnerable to natural disasters.

SMART GRID
Key Success Factors

Economic

An economic grid operates under the basic laws of supply and demand, resulting in fair prices and adequate supplies.

SMART GRID
Key Success Factors

Efficient

An efficient grid takes advantage of investments that lead to cost control, reduced transmission and distribution electrical losses, more efficient power production and lower costs of ownership.

SMART GRID
Key Success Factors

Environmentally friendly

An environmentally friendly grid reduces environmental impacts through initiatives in generation, transmission, distribution, storage and consumption.

SMART GRID
Key Success Factors

Safe

A safe grid does no harm to the public or to grid workers and is sensitive to users who depend on it for life safety.

SMART GRID


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Performance
Principal Characteristics
Key Technology Areas
Metrics
Key Success Factors

SMART GRID
Performance requirements

- Emergency response
- Restoration
- Routine operations
- Optimization
- System planning

SMART GRID
Performance requirements

Emergency response

- A modern grid provides advanced analysis to predict problems before they occur and to assess problems as they develop. This allows steps to be taken to minimize impacts and to respond more effectively.

SMART GRID
Performance requirements

Restoration

- It can take days or weeks to return today's grid to full operation after an emergency. A modern grid can be restored faster and at lower cost as better information, control and communications tools become available to assist operators and field personnel.

SMART GRID
Performance requirements

Routine operations

- With a modern grid, operators can understand the state and trajectory of the grid, provide recommendations for secure operation, and allow appropriate controls to be initiated. They will depend on the help of advanced visualization and control tools, fast simulations and decision support capabilities

SMART GRID
Performance requirements

Optimization

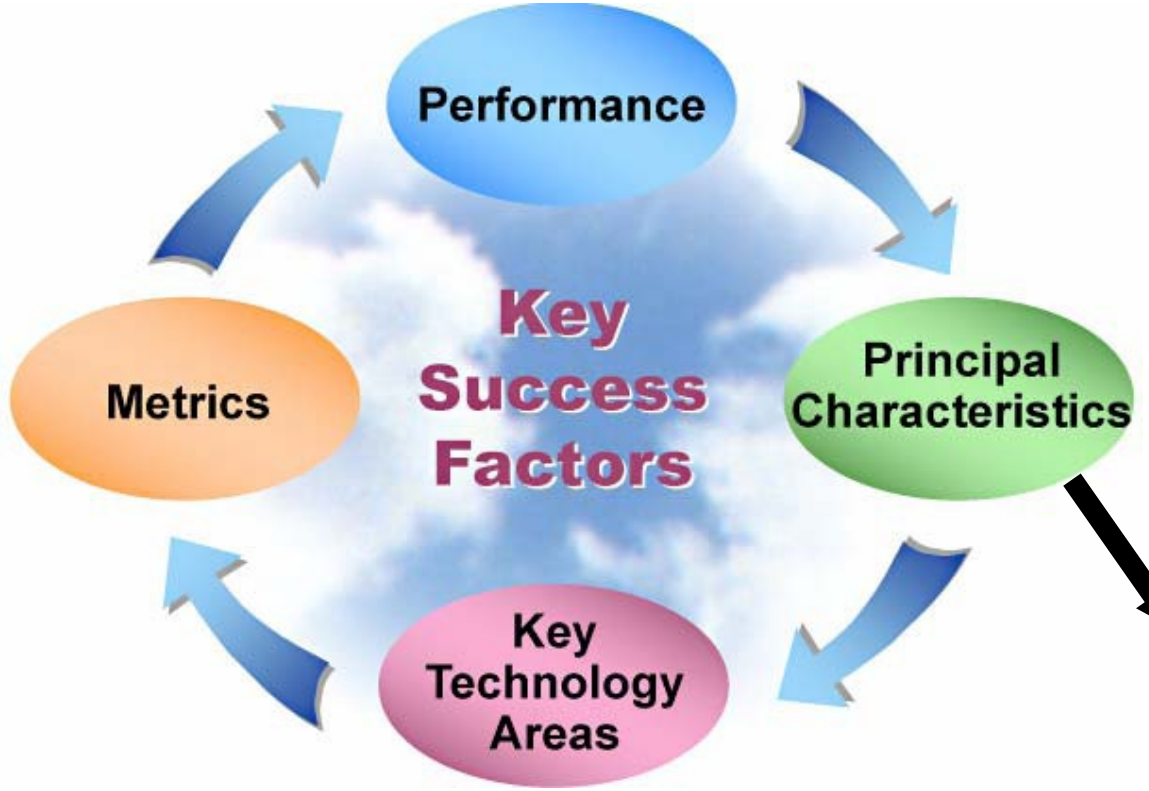
- The modern grid provides advanced tools to understand conditions, evaluate options and exert a wide range of control actions to optimize grid performance from reliability, environmental, efficiency and economic perspectives.

SMART GRID
Performance requirements

System planning

- Grid planners must analyze projected growth in supply and demand to guide their decisions about what to build, when to build and where to build. Modern grid data mining and modeling will provide much more accurate information to answer those questions.

SMART GRID


Performance
Principal Characteristics
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SMART GRID
Principle Characteristics

Seven principal characteristics comprise the third element of the systems view. They emerge from the first element's key success factors and the second element's performance requirements. In the systems view, the modern grid:

- Self-heals
- Motivates and includes the consumer
- Resists attack
- Provides power quality for 21st century needs
- Accommodates all generation and storage options
- Enables markets
- Optimizes assets and operates efficiently

SMART GRID
Principle Characteristics

SELF-HEALS

- The modern grid will perform continuous self-assessments to detect, analyze, respond to, and as needed, restore grid components or network sections. Self-healing will help maintain grid reliability, security, affordability, power quality and efficiency.

SMART GRID
Principle Characteristics

MOTIVATES AND INCLUDES THE CONSUMER

- The active participation of consumers in electricity markets brings tangible benefits to both the grid and the environment, while reducing the cost of delivered electricity.

SMART GRID
Principle Characteristics

RESISTS ATTACK

- Security requires a system-wide solution that will reduce physical and cyber vulnerabilities and recover rapidly from disruptions.

SMART GRID
Principle Characteristics

PROVIDES POWER QUALITY FOR 21ST CENTURY NEEDS

- The modern grid will provide the quality of power desired by today's users, as reflected in emerging industry standards.

SMART GRID
Principle Characteristics

ACCOMMODATES ALL GENERATION AND STORAGE OPTIONS

- The modern grid will seamlessly integrate many types of electrical generation and storage systems with a simplified interconnection process analogous to “plug-and-play”.

SMART GRID
Principle Characteristics

ENABLES MARKETS

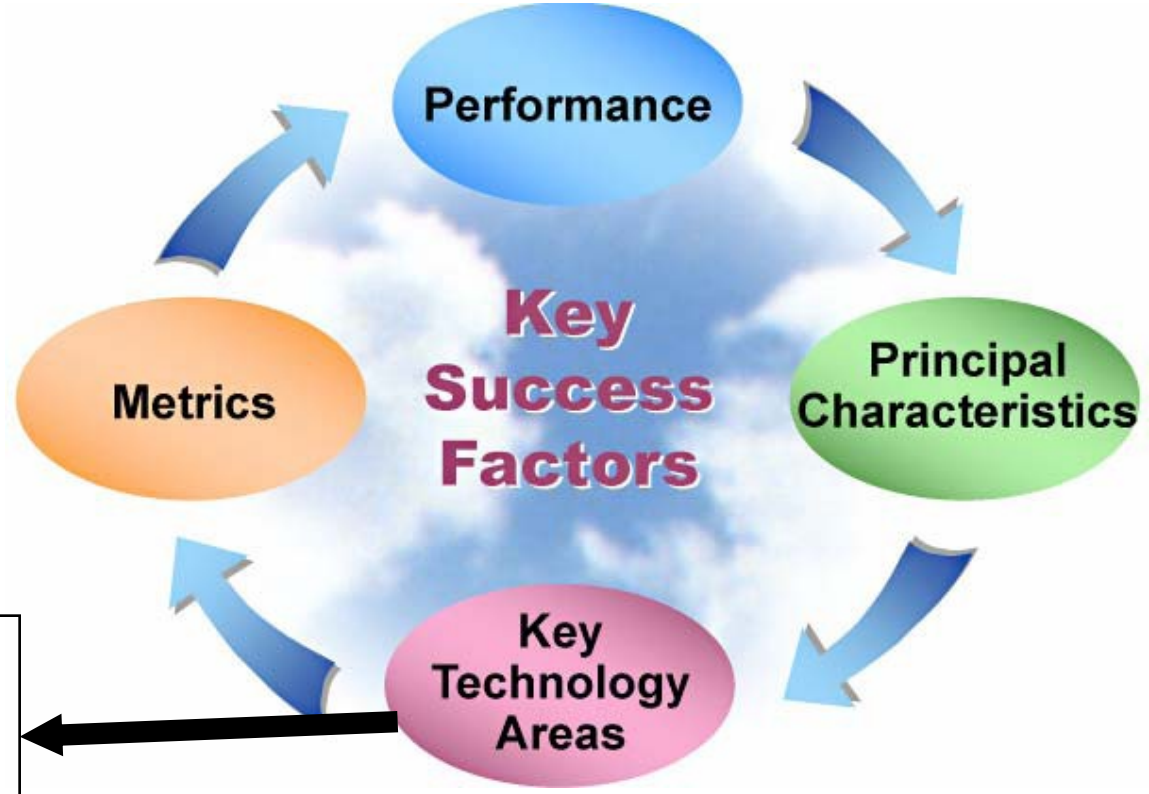
- This characteristic is particularly important because open-access markets expose and shed inefficiencies. The modern grid will enable more market participation through increased generation paths, more efficient aggregated demand response initiatives and the placement of energy storage and resources within a more reliable distribution system.

SMART GRID
Principle Characteristics

OPTIMIZES ASSETS AND OPERATES EFFICIENTLY

- The modern grid's assets and its maintenance will be managed in concert with one goal: to deliver desired functionality at minimum cost.

SMART GRID


Performance
Principal Characteristics
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Key Success Factors

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SMART GRID
Key Technology Areas

Five key technology areas are needed to achieve the principal characteristics. These technologies have been proven in other industries and are essential to realizing the smart grid vision:

- Integrated Communications
- Sensing and Measurement
- Advanced Components
- Advanced Control Methods
- Improved Interfaces and Decision Support

SMART GRID
Key Technology Areas

Integrated Communications

- High-speed, fully integrated, two-way communication technologies will make the modern grid a dynamic, interactive “mega-infrastructure” for real-time information and power exchange. Open architecture will create a plug-and-play environment that securely allows networks grid components to talk, listen and interact.

SMART GRID
Key Technology Areas

Sensing and Measurement

- These technologies will enhance power system measurements and enable the transformation of data into information. They evaluate the health of equipment and the integrity of the grid and support advanced protective relaying; they eliminate meter estimations and prevent energy theft. They enable consumer choice and demand response, and help relieve congestion.

SMART GRID
Key Technology Areas

Advanced Components

- Advanced components play an active role in determining the grid's behavior. The next generation of these power system devices will apply the latest research in materials, superconductivity, energy storage, power electronics, and microelectronics. This will produce higher power densities, greater reliability and power quality, enhanced electrical efficiency producing major environmental gains and improved real-time diagnostics.

SMART GRID
Key Technology Areas

Advanced Control Methods

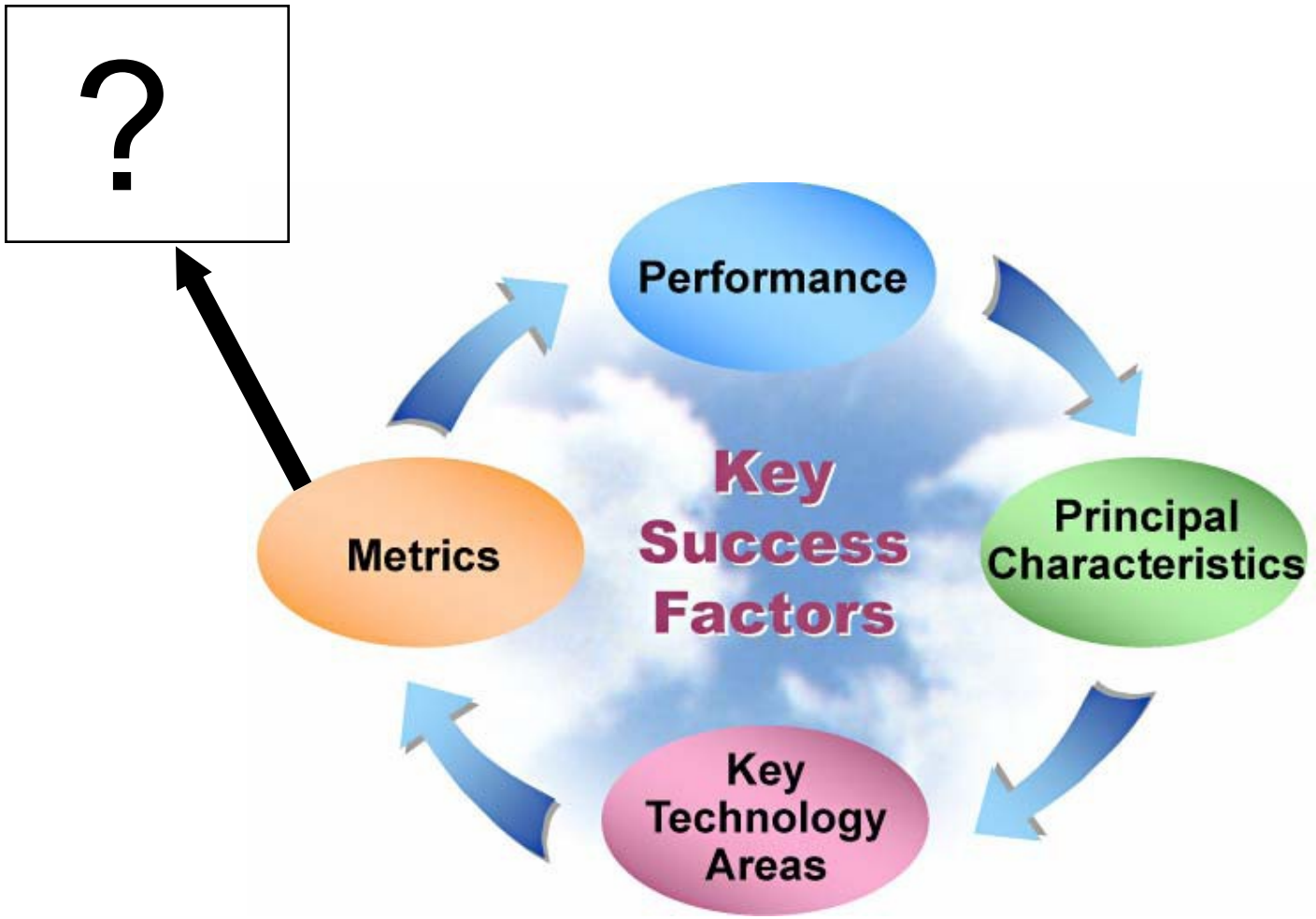
- New methods will be applied to monitor essential components, enabling rapid diagnosis and timely, appropriate response to any event. They will also support market pricing and enhance asset management and efficient operations

SMART GRID
Key Technology Areas

Improved Interfaces and Decision Support

- In many situations, the time available for operators to make decisions has shortened to seconds. Thus, the modern grid will require wide, seamless, real-time use of applications and tools that enable grid operators and managers to make decisions quickly. Decision support with improved interfaces will amplify human decision making at all levels of the grid.

SMART GRID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SMART GRID METRICS

Collaboratively developed metrics enable consumers, utilities, and other industry participants to evaluate the effectiveness of the modern grid.

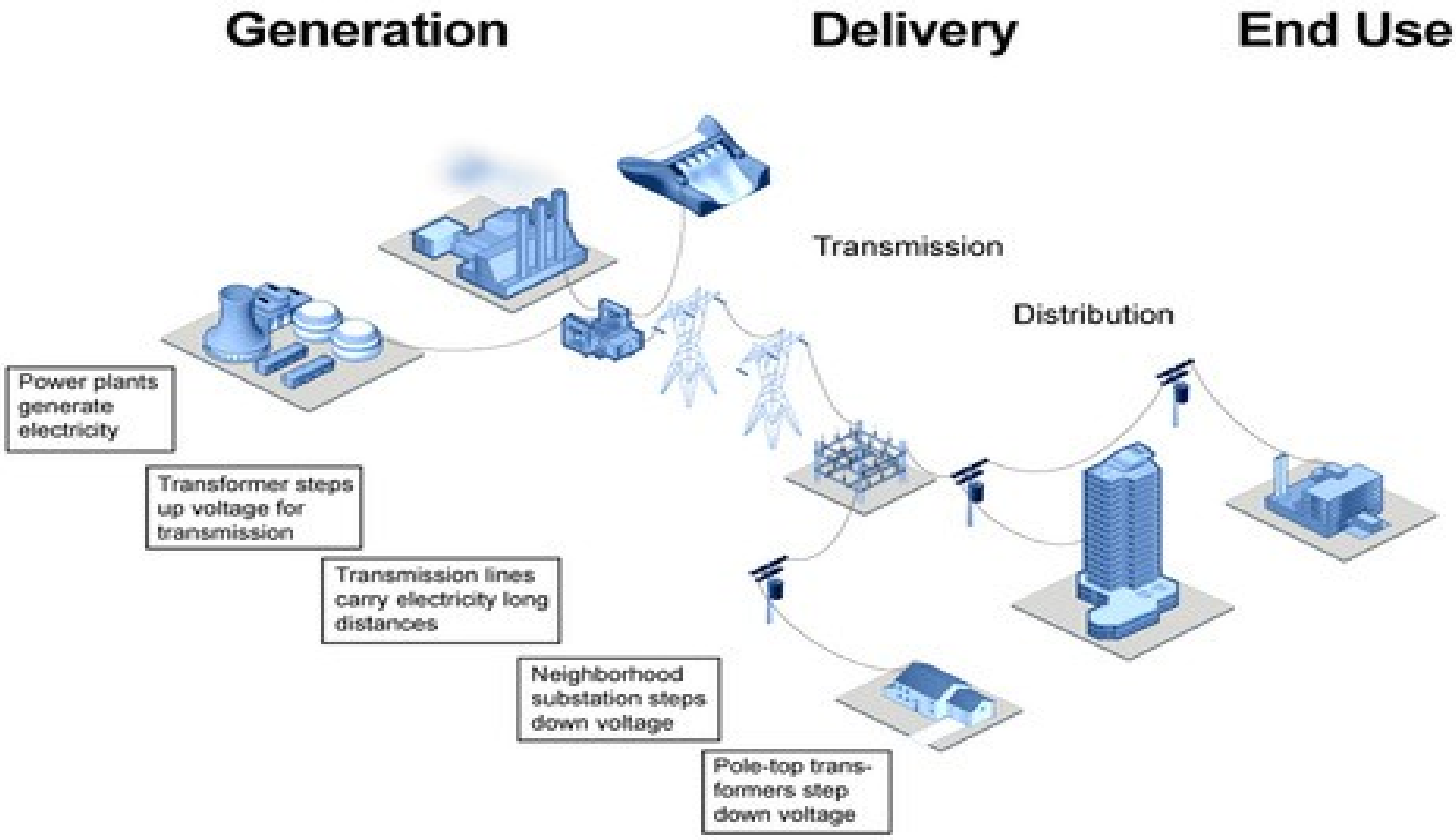
An initial set of metrics that are deemed important:

- Customer Average Interruption Duration Index (CAIDI)
- Cost of Interruptions and power quality disturbances
- Ratio of distributed generation to total generation
- Ratio of renewable generation to total generation
- Peak and average energy prices by region
- Peak-to-average load ratio
- Transmission congestion costs
- Duration congested transmission lines are loaded >90%
- System electrical losses
- Consumers participating in energy markets
- Total cost of delivered energy
- Emissions per kilowatt-hour delivered

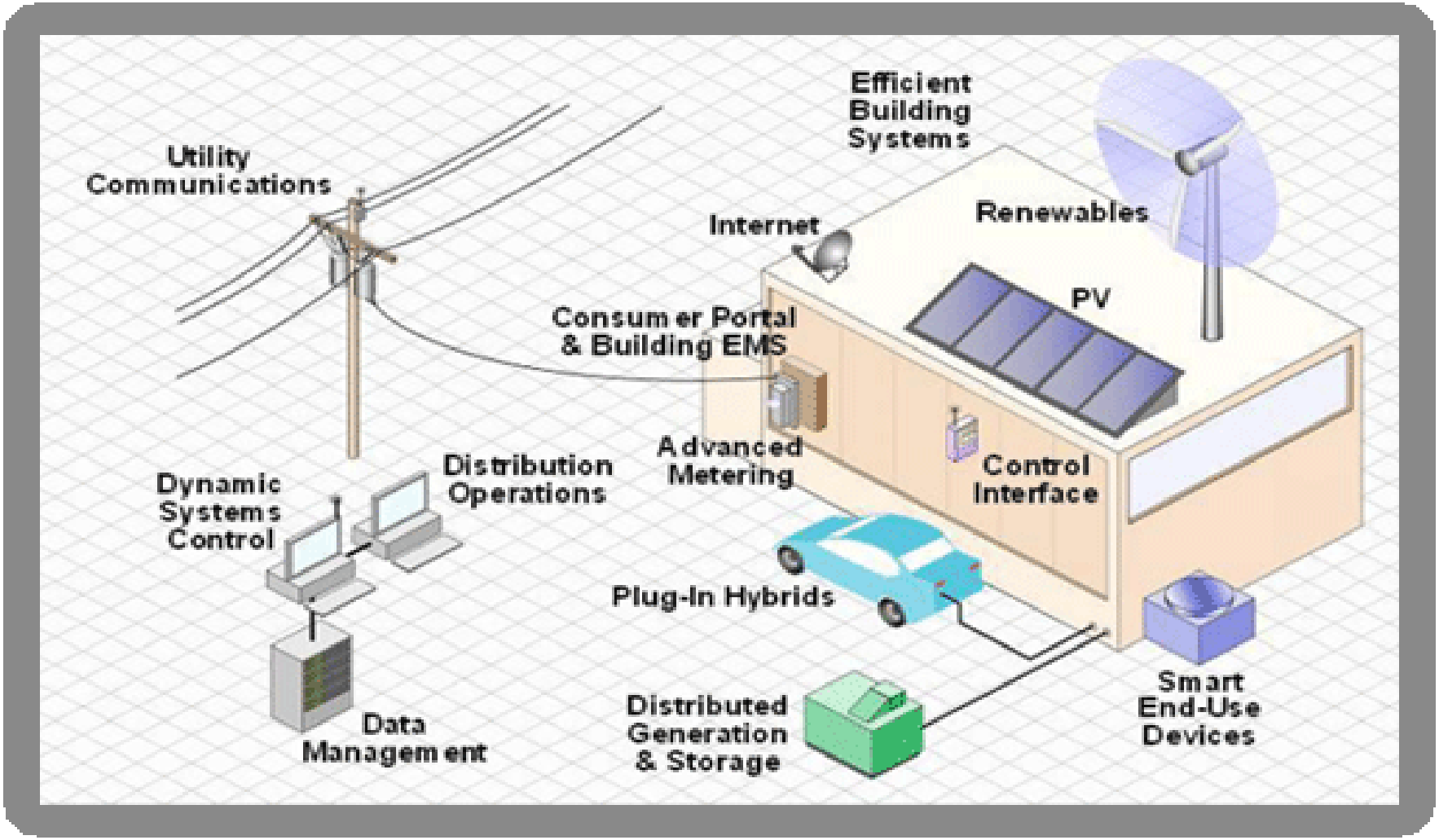
SMART GRID Summary

Key Success factors	Performance	Principle Characteristics	Key Technology Areas	Metrics
Reliable	Emergency Response	Self heals	Integrated communications	Customer average interruption index
Secure	Restoration	Motivates and includes the consumer	Sensing and measurement	Cost of interruption and power quality disturbances
Economic	Routine operations	Resists attack	Advanced components	Ratio of distributed generation to total generation
Efficient	Optimization	Provides power quality for the 21st century	Advanced control methods	Ratio of renewable generation to total generation
Environmentally Friendly	System Planning	Accommodates all generation and storage options	Improved interfaces and decision support	Peak and average energy prices
Safe		Enables markets		Peak to average load ratio
		Optimizes assets and operates efficiently		Transmission congestion costs
				Duration congested transmission losses are loaded
				System electrical losses
				Consumers participating in energy markets
				Total cost of delivered energy
				Emissions per kilowatt-hour delivered

SMART GRID
Traditional grid



SMART GRID
Consumer systems



The Smart Grid

Smart Grid

A Dream !!!!!!!!!

Or

Nightmare !!!!!!!

The implementation of the smart grid in the electrical energy supply system will impose new solutions to the challenges faced by supply authorities. Just as the communication revolution changed the way we see telephones the smart grid will change the traditional way of supplying electricity. If we do not accept the changes it could become a nightmare but ride with the wave of change and I believe we will experience it as a dream come true.

Smart Grid

Thank you