



THE SHPIGLER GROUP
STRATEGY MANAGEMENT CONSULTING SERVICES

Developing the Smart Grid

Utility Benefits and Costs



Prepared for:

Illinois Smart Grid Initiative

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The drive to pursue status as a “Next Generation” utility is based on the realities of a rapidly changing market dynamic

- Environment – Concerns over environmental impact of utility operations are at all time high. Awareness of issues involving greenhouse gases and the promotion of “green power” has never before been at such a high level in the public consciousness. Utilities are being pressured from many fronts to adopt business practices to respond to global environmental concerns.
- Customer Demands – The requirements of customers has also never been as high as they are today. Furthermore, the demands of customers are expected to rise even further in the years ahead. Larger houses, exponentially larger amounts of electric usage, and higher expectations for reliable service in a digital economy have given rise to a more demanding customer that is less tolerant to service interruptions than ever before.
- Energy Concerns – Given the global political climate, there is now a dramatic focus on the energy sector to respond to energy issues by adopting business practices that provide assurances that energy can be delivered to end-users reliably, continuously, and cost-effectively. With concerns over rising energy costs, many utilities are actively seeking ways to modify long-term strategies by ensuring that fail-safe provisions are accounted for.

These changes may represent the most significant shift in the dynamic of the energy market in a century.

The characteristics of the next generation utility will be very different

- Legacy Operations -

Electromechanical/Analog
One-way communications (if any)
Built for centralized generation
Radial topology
Few sensors
"Blind"
Manual restoration
Prone to failures and blackouts
Check equipment manually
Emergency decisions by committee and phone
Limited control over power flows
Limited price information
Few consumer choices

- Next Gen Operations -

Digital
Two-way communications
Accommodates distributed generation
Network topology
Monitors and sensors throughout
Self-monitoring
Semi-automated restoration and eventually, self-healing
Adaptive protection and islanding
Check equipment remotely
Decision support systems, predictive reliability
Pervasive control systems
Full price information
Many consumer choices

Source: PJM

The Department of Energy has put forth a vision for future development that lays out a potential vision for the “Next Generation” utility

- As a result, utilities are following a vision that can guide them in developing future strategies in terms of their capital expenses, budget planning, technology development, customer services, etc.

Vision 2010:

- Smart meter enabled with two way communication
- Intelligent home and smart appliances
- Demand side management & distributed generation
- Advanced conductors and higher transmission capacity

Vision 2020:

- Perfect power quality through automatic correction for voltage, frequency, and power factor issues
- HTS generation, transformers, and cables will make a significant difference
- Superconducting cables for long distance transmission

Vision 2030:

- Reliable and secure digital grade power for customer
- Access to affordable pollution-free, low-carbon electricity generation produced anywhere in the country
- Affordable energy storage devices available to anyone
- Completion of a national superconducting backbone

Source: Department of Energy

Public policy entities have been united in their goal to promote smart grid network deployment



DOE “Grid 2030”

“A National Vision for Electricity’s
Second 100 years”

A Call for Leadership – The Nation’s aging electro-mechanical electric grid cannot keep pace with innovations in the digital information and telecommunications network. Power outages and power quality disturbances cost the economy billions of dollars annually. America needs an *electric* superhighway to support our information superhighway.

(US DOE July 2003)

PURPA - Public Utility Commission

Each electric utility shall offer and provide individual customers upon customer request, a time-based rate schedule under which the rate charged... varies during different time periods

(Public Utilities Regulatory Policy Act - PURPA)

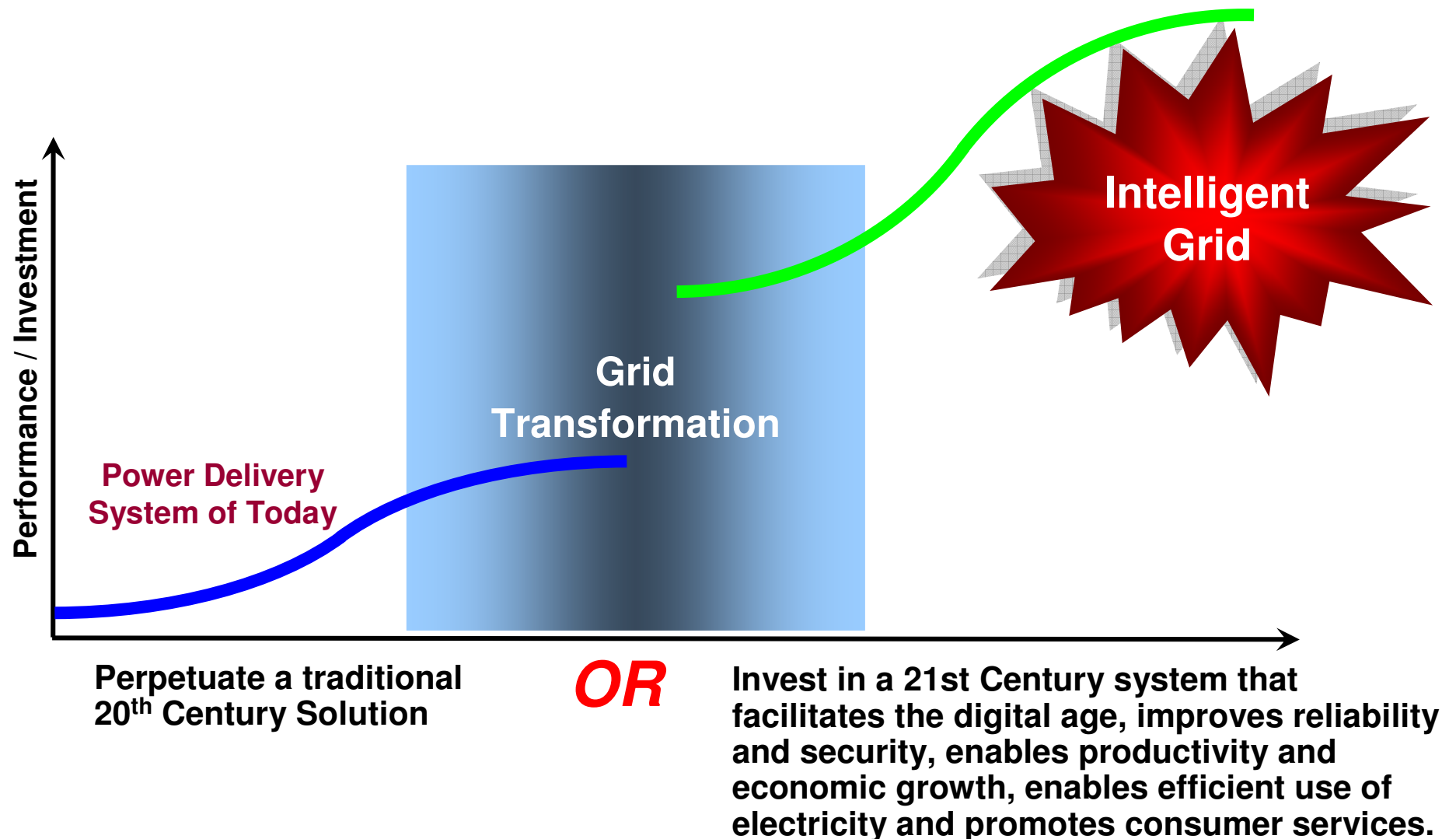
FERC

“**Assessment of Demand Response & Advanced Metering**”

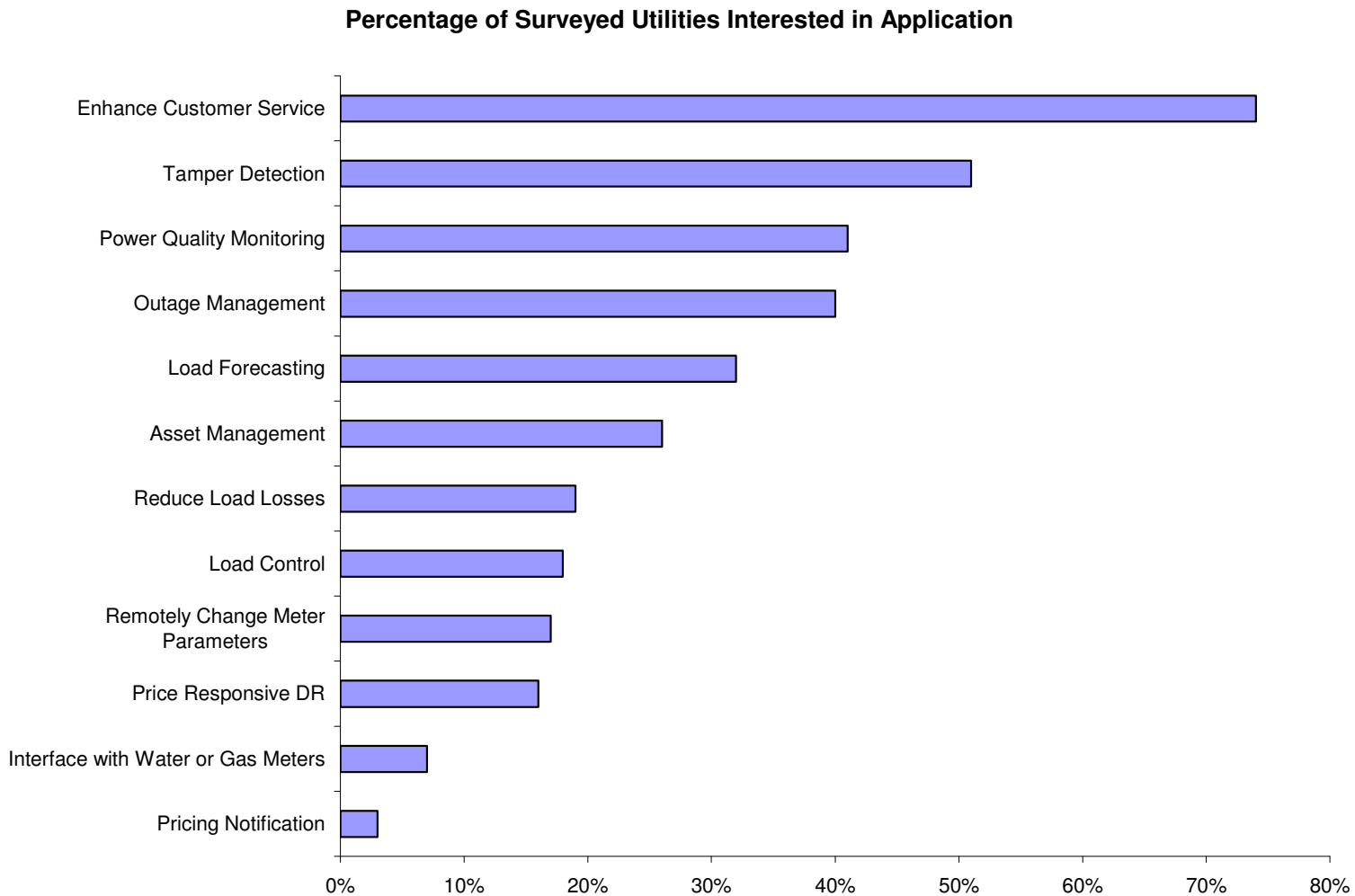
Demand response has an important role to play in both wholesale and retail markets... Staff encourages states to consider ways to actively encourage demand response at a retail level.

(August 2006 Staff Report)

According to the DOE Grid 2030 report, the U.S. will require investment of \$450 billion on electric infrastructure to meet load growth – the decision is where will that money be spent?

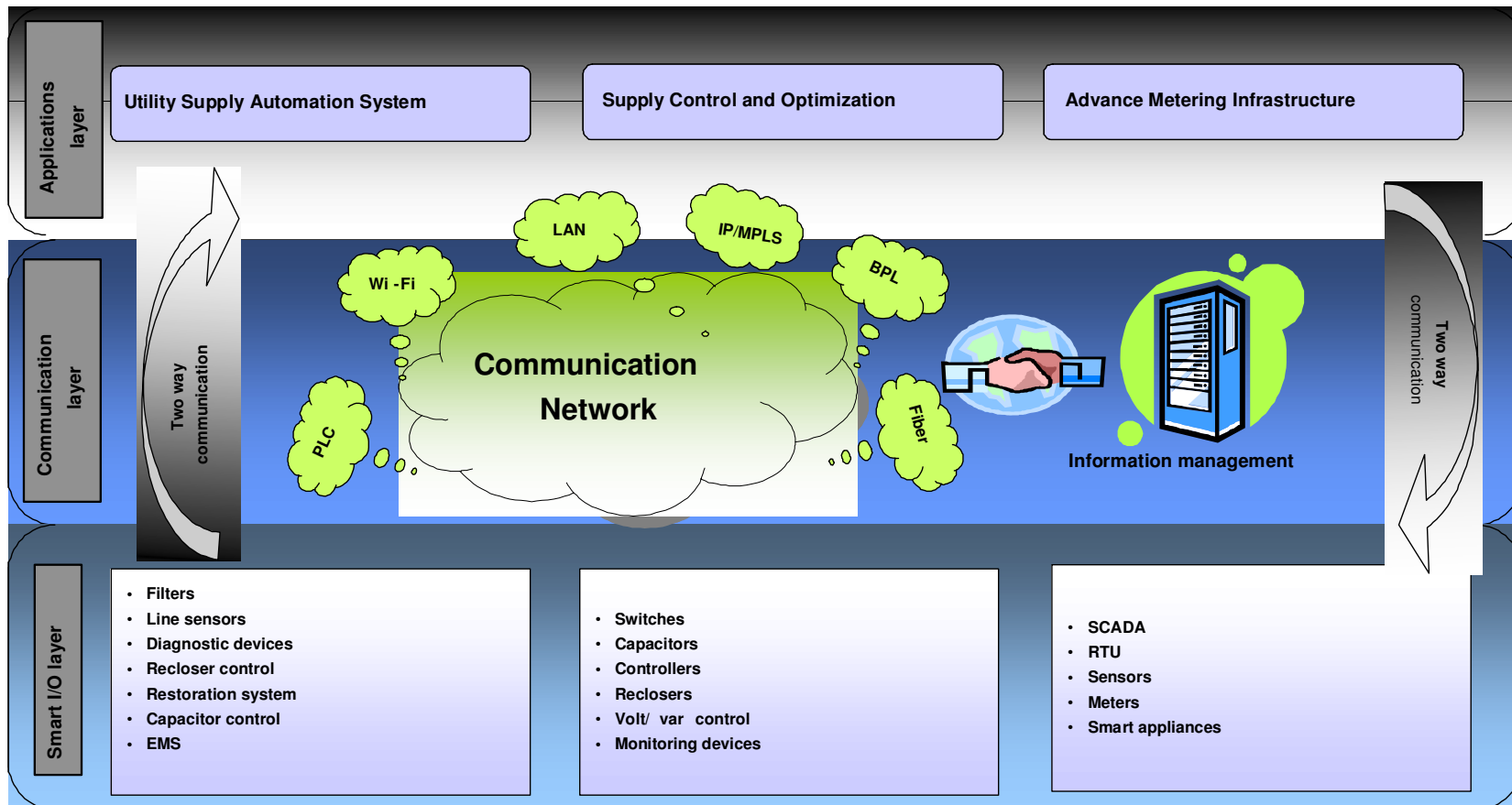


The specific uses of a “smart grid” can vary quite widely among differing utilities based on their individual needs



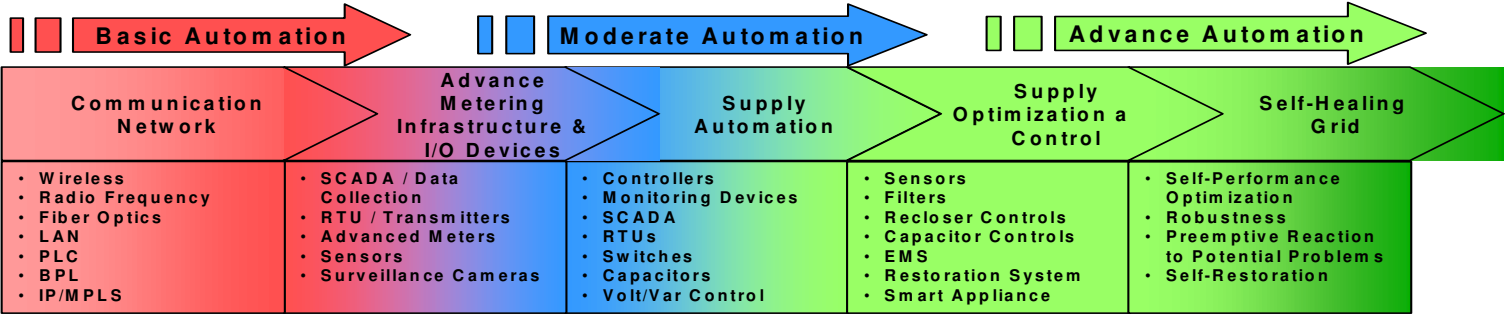
Source: FERC

While there are numerous applications that can be supported with the development of a smart grid, none of the value can be realized without ensuring that appropriate support systems are put in place first



Extensive surveying and research shows that major utilities are approaching Smart Grid with differing levels of commitment for short-term deployment strategies

- Advancement of Smart Grid technology varies on the basis of regulatory context, senior management disposition, and funding capabilities



Less Regulatory Pressure



More Regulatory Pressure

Less Cohesive Management Vision



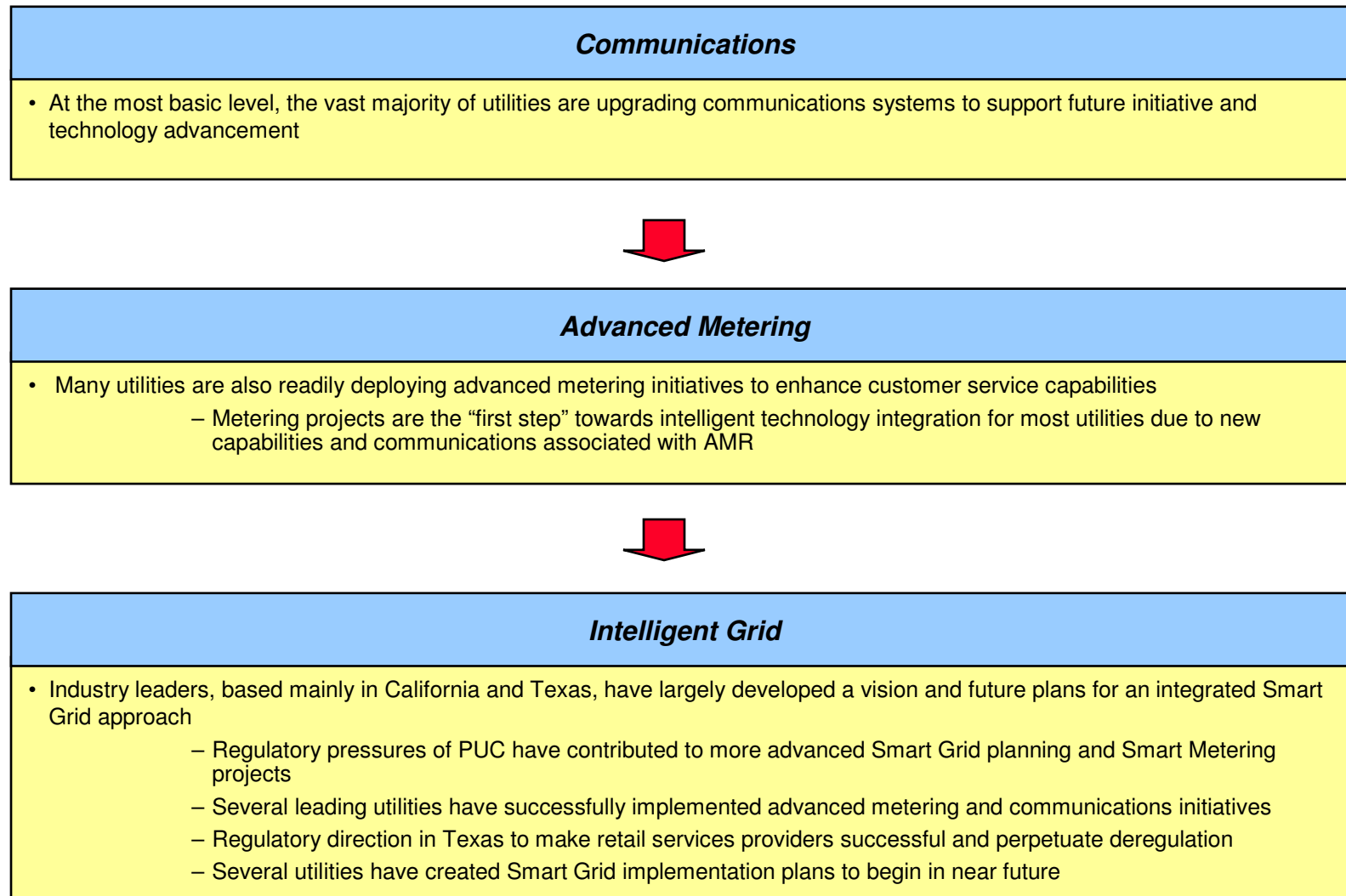
More Cohesive Management Vision

Smaller Funding Capabilities



Greater Funding Capabilities

Each utility chooses an appropriate strategy integrating different levels of intelligent technology advancement, ranging from basic communications initiatives to plans for intelligent grid implementation

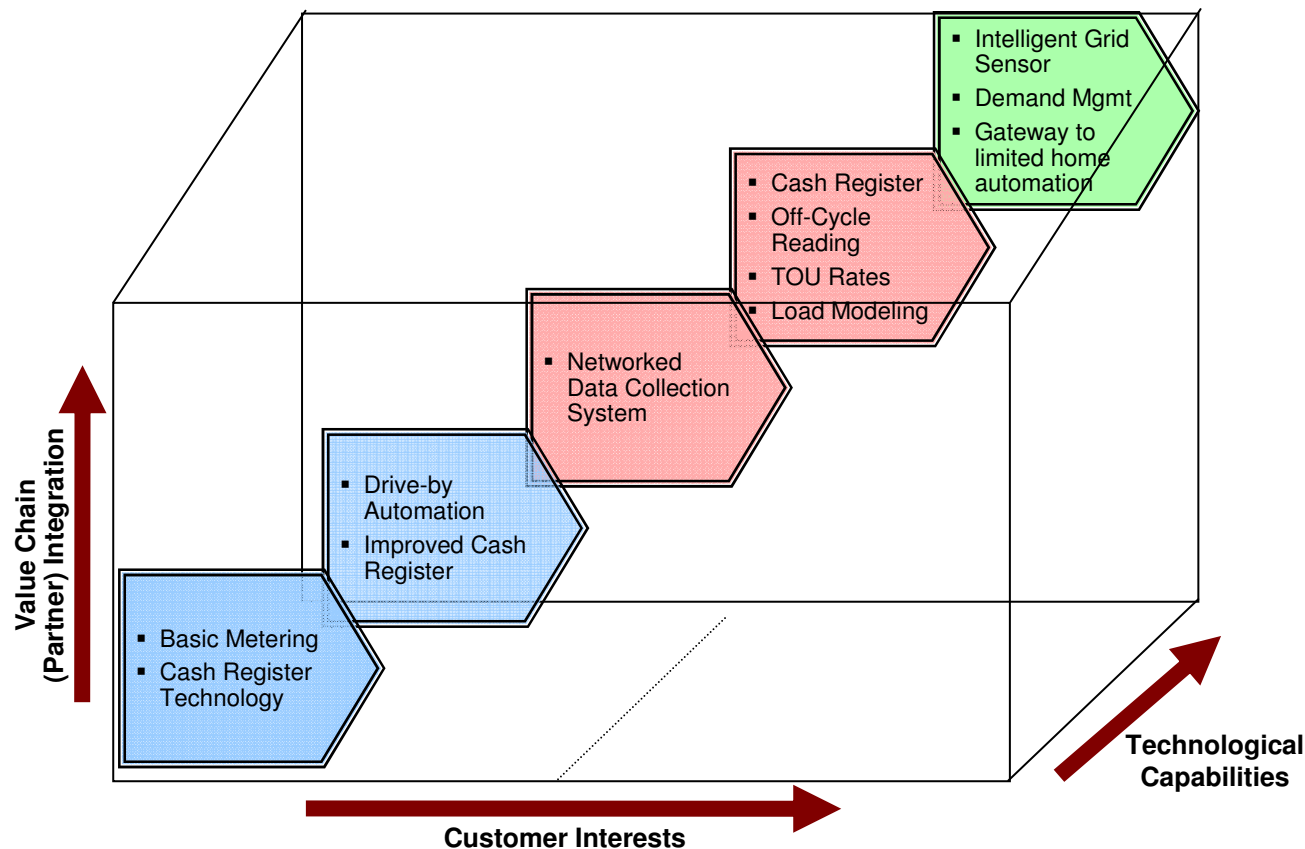


Technology advances focus on a convergence of overlapping functionality and integration to enjoy greater efficiencies

<i>Trend</i>	<i>Significance</i>
Technology Convergence	<ul style="list-style-type: none"> • Utilities enjoy cost savings through common platforms supporting multiple applications • Smart Grid can eliminate redundant operations and create efficiency • Use common communication network for supply automation and AMI
Global Advancement	<ul style="list-style-type: none"> • Globally, AMR and smart meters are becoming more salient in European and other international markets • 80% of smart meter sales still in US
Next Generation Communication Network	<ul style="list-style-type: none"> • Pursued to create operational efficiency and productivity • Use of new technologies to shift from traditional applications to more efficient IP/MPLS technology and new IP-based solutions
Evolving Materials and Technologies	<ul style="list-style-type: none"> • Enhance operational efficiencies of utilities • Fiber optics in communications, chips and semiconductors in hardware, superconducting wires in transmission and distribution

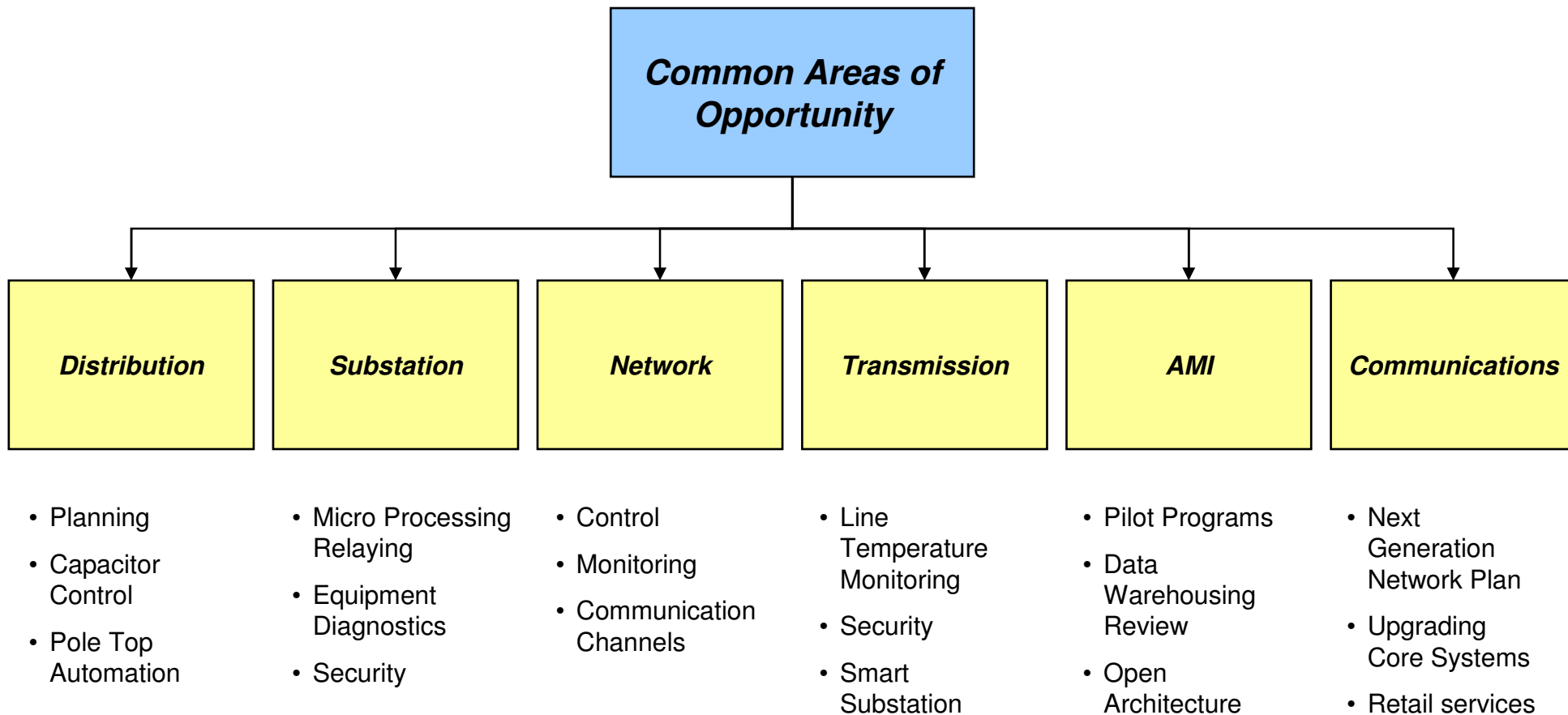
The business and operational plan can allow utilities to migrate meters from a “cash register” to an automation sensor

Evolving Role of Metering

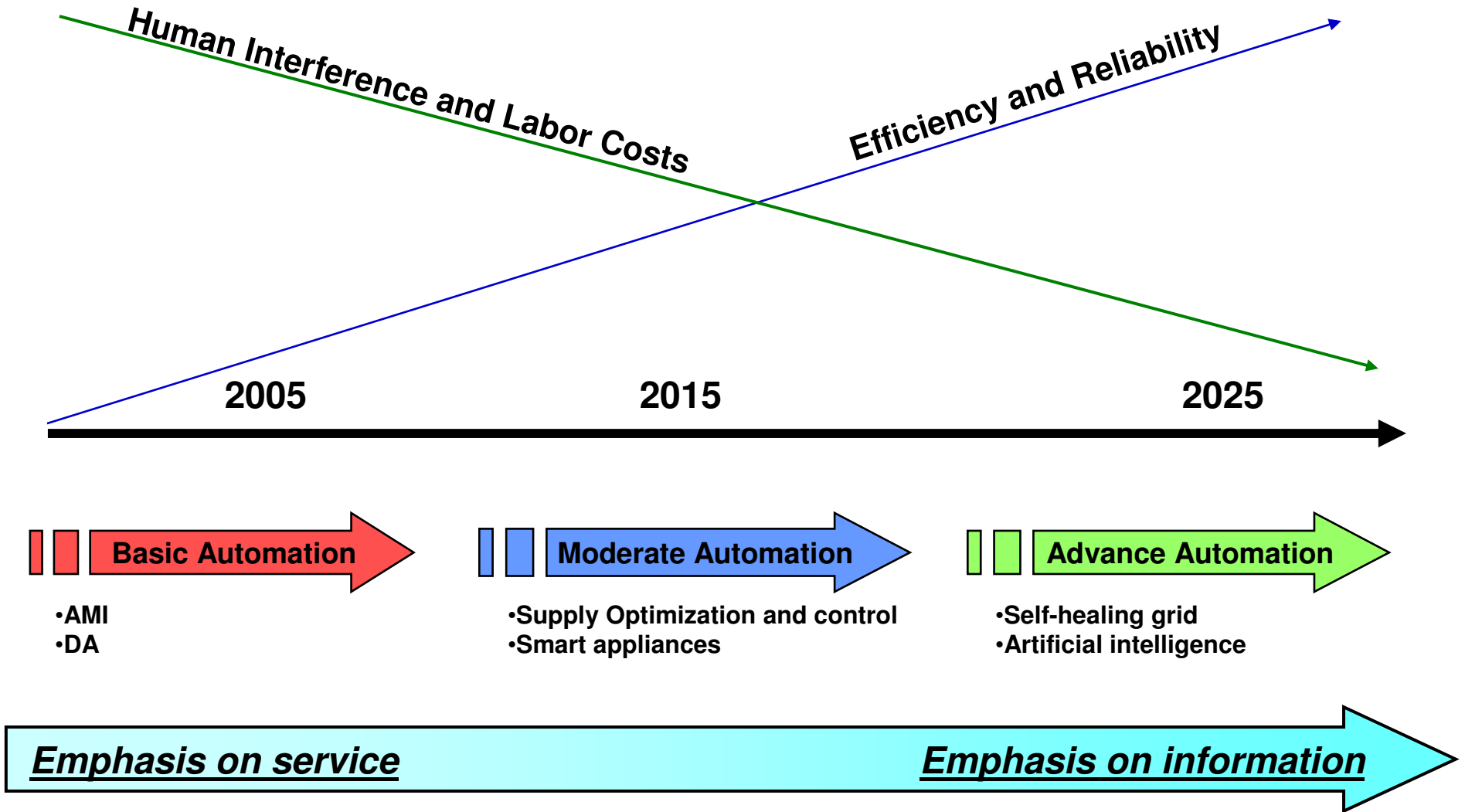


- Prepaid metering programs
- Time based rate support
- Outage and restoration notification
- Self serve customer usage portals
- Remote (automated) service connect/disconnect
- Advanced distribution management
- Self healing distribution systems
- Load Modeling
- Demand Response

There are a number of key areas that can yield synergies between existing initiatives and smart grid efforts

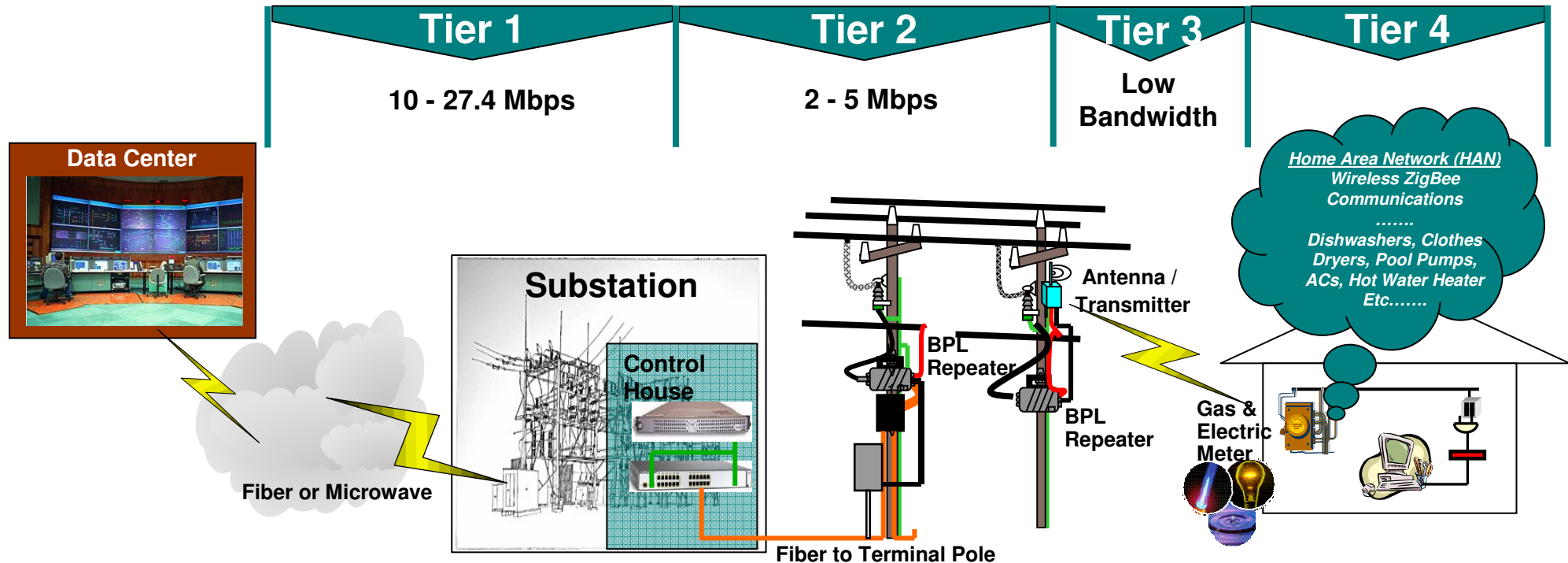


As the automation system moves towards the advance state, it requires minimal human interference and promises extreme efficiency and greater reliability



Ultimately, the network chosen can feature a tandem of different network components to get the job done

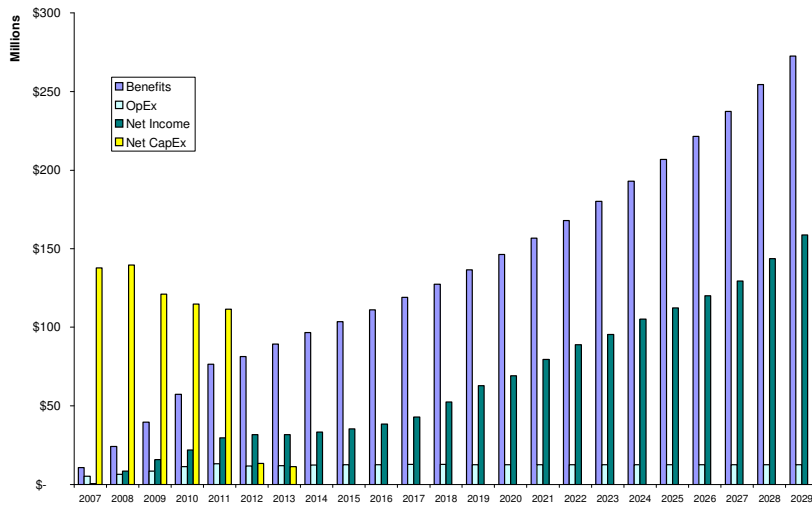
- Tier 1 – Major backhaul: Data Center to the substations
- Tier 2 – Minor backhaul: Substations to the IG device or meter relay
- Tier 3 – Bi-directional Meter to Meter to Relay to Meter
- Tier 4 – Meter to ZigBee wireless home area network (HAN) or alternative solution



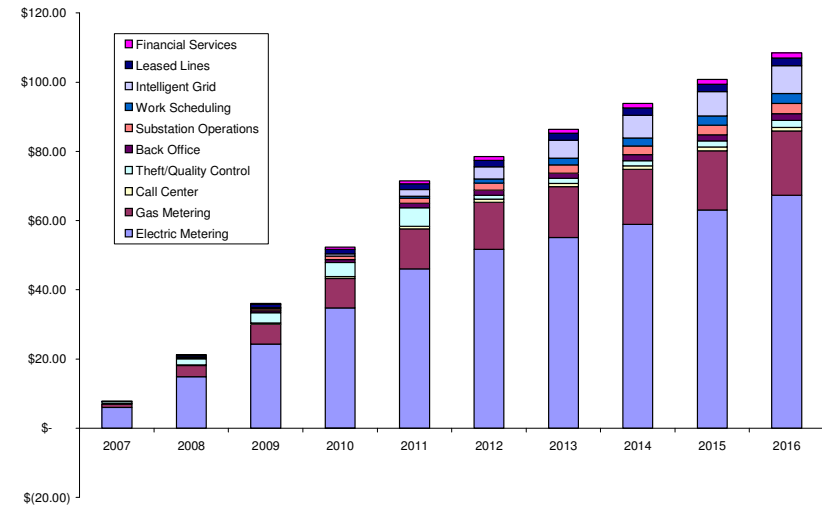
Source: CenterPoint Energy

In the end it is important to be able to document financial viability of the proposed system using detailed financial analysis tools

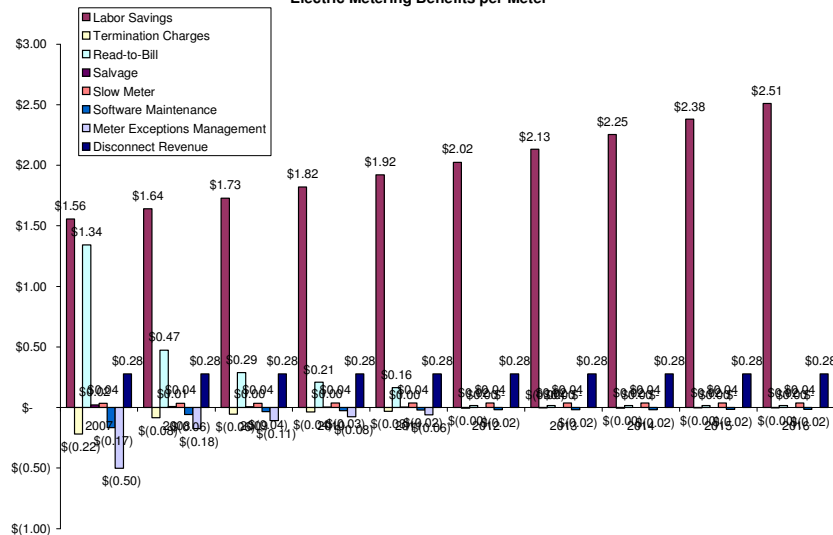
Scenario 5 Financial Projections



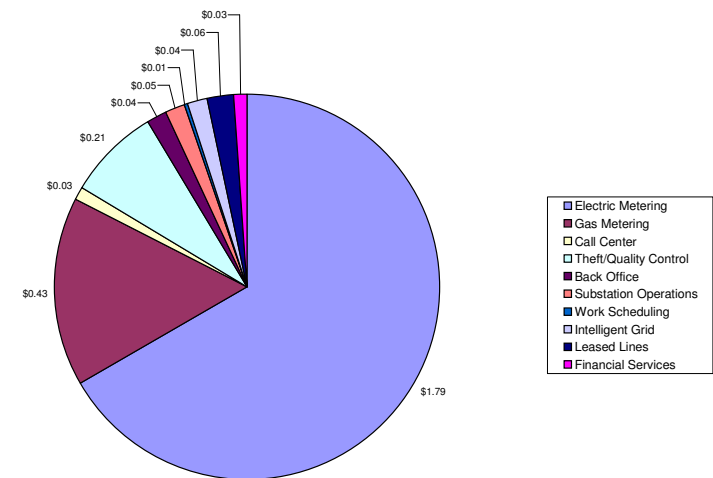
Sources of Value (\$MM)



Electric Metering Benefits per Meter



Distribution of Benefits (per Meter)

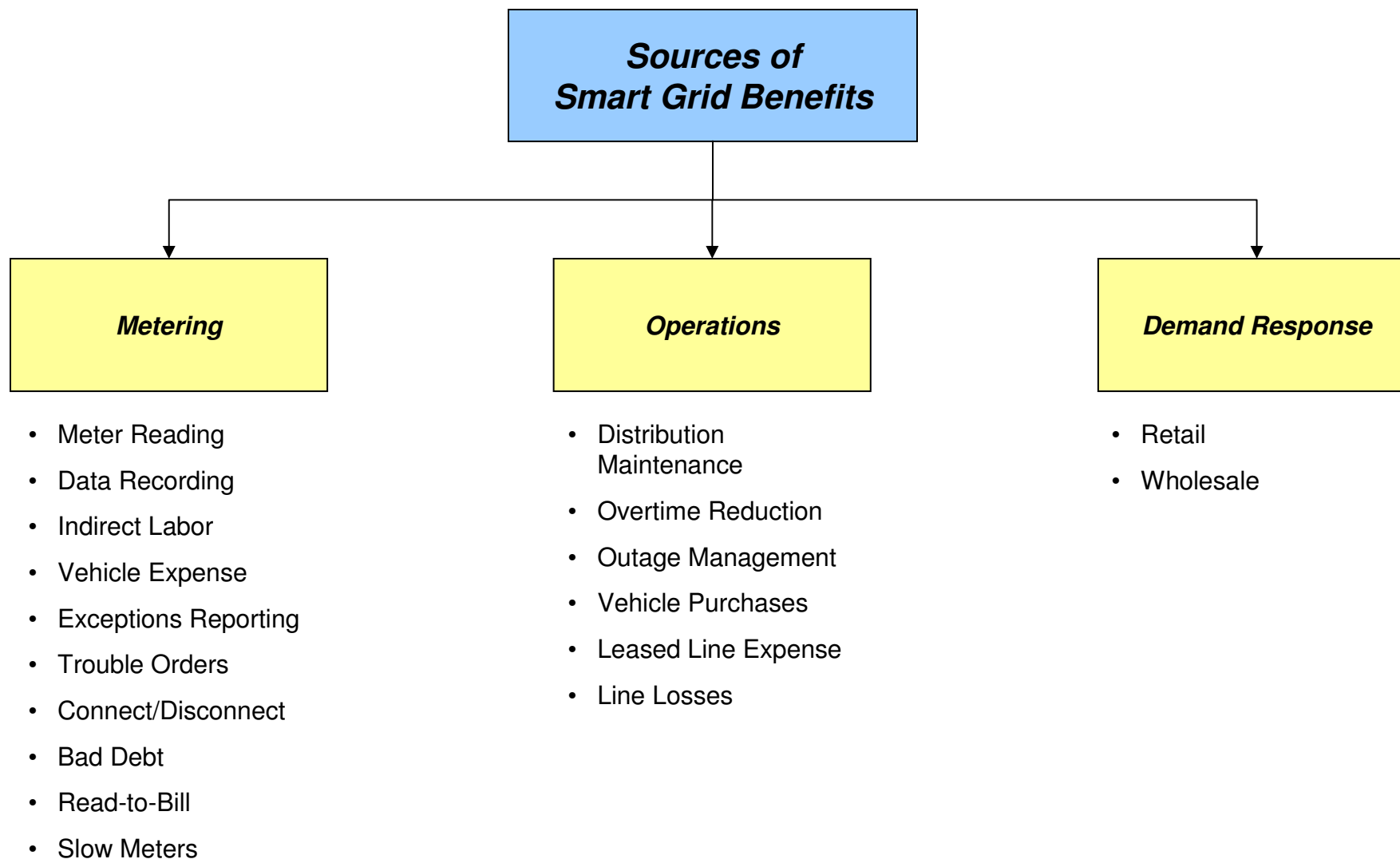


Each of the Smart Grid benefits can be attributed to a specific application for either the delivery or use of electricity

- Most of the transmission and distribution applications would require substantial equipment upgrades
- The end use applications are enabled by technology, but made successful by the implementation of customer programs and marketing efforts
- Both would require a more developed communications platform and integrated information management

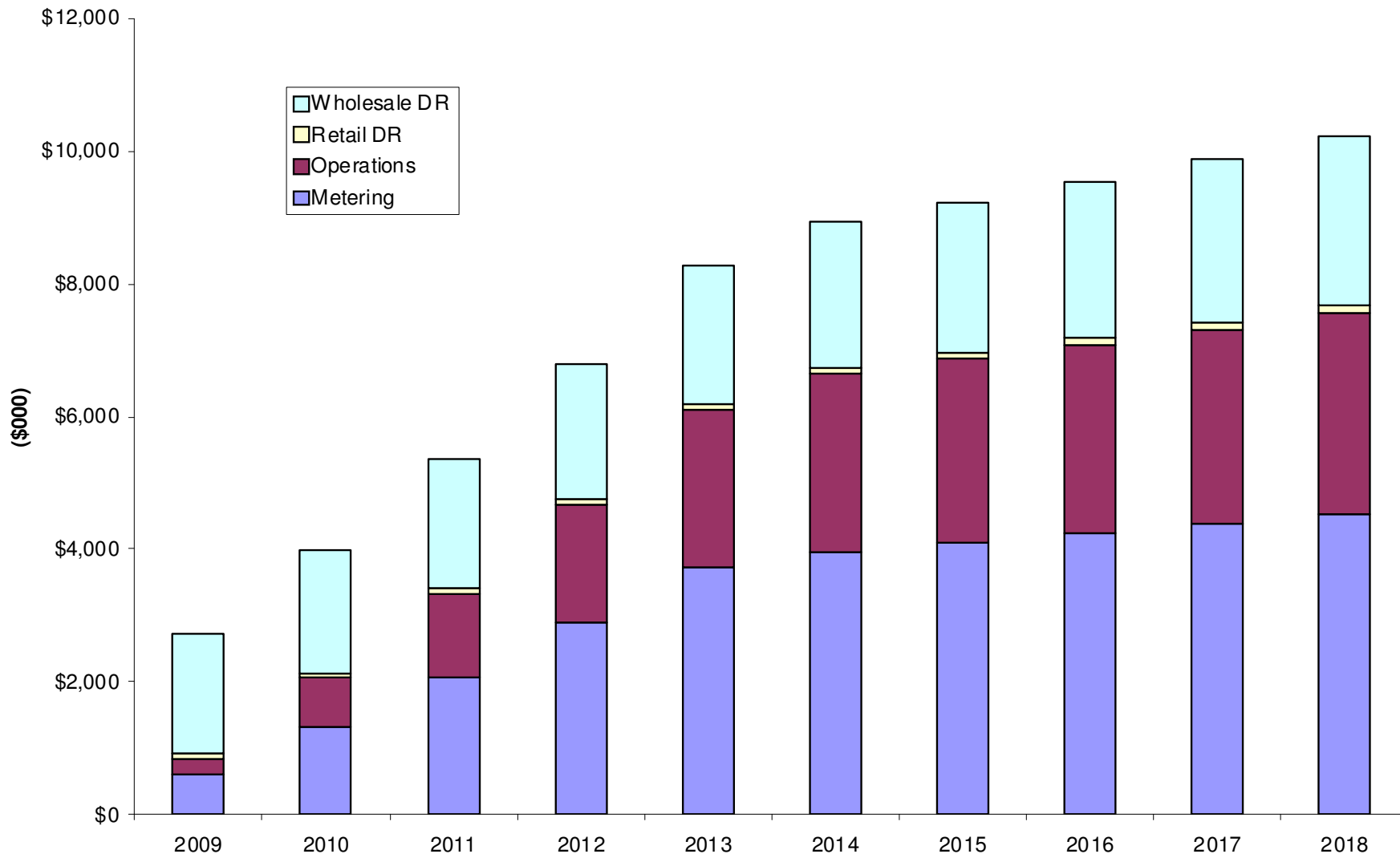
		<i>Requirements</i>	<i>Benefits</i>
Transmission & Distribution	Advanced Metering	Advanced meters	Reduced meter expenses & ability to offer advanced customer programs
	Load Management	AMI and software	Demand side control reduces peak purchases and system overloads
	Power Monitoring	AMI, IEDs, and software	Reduction in maintenance expenses, improved operations and services
	Quality Control & Fault Localization	IEDs on the line, software, and automated switches	Problem prevention, improved supply quality and reduced restoration times
End Users	Net Metering	Net-metering capable meters	Customers can “sell” electricity back to the utility and prevent peak usage
	Variable Pricing	Meters capable of incremental reads and customer programs	Reduced monthly bills
	Load Control	Load control devices for appliances and customer programs	Reduced monthly bills, less outages
	Prepay Metering	Prepay-capable meters or software	Ability to monitor usage better and control costs

A Smart Grid system can generate financial benefit in a number of areas



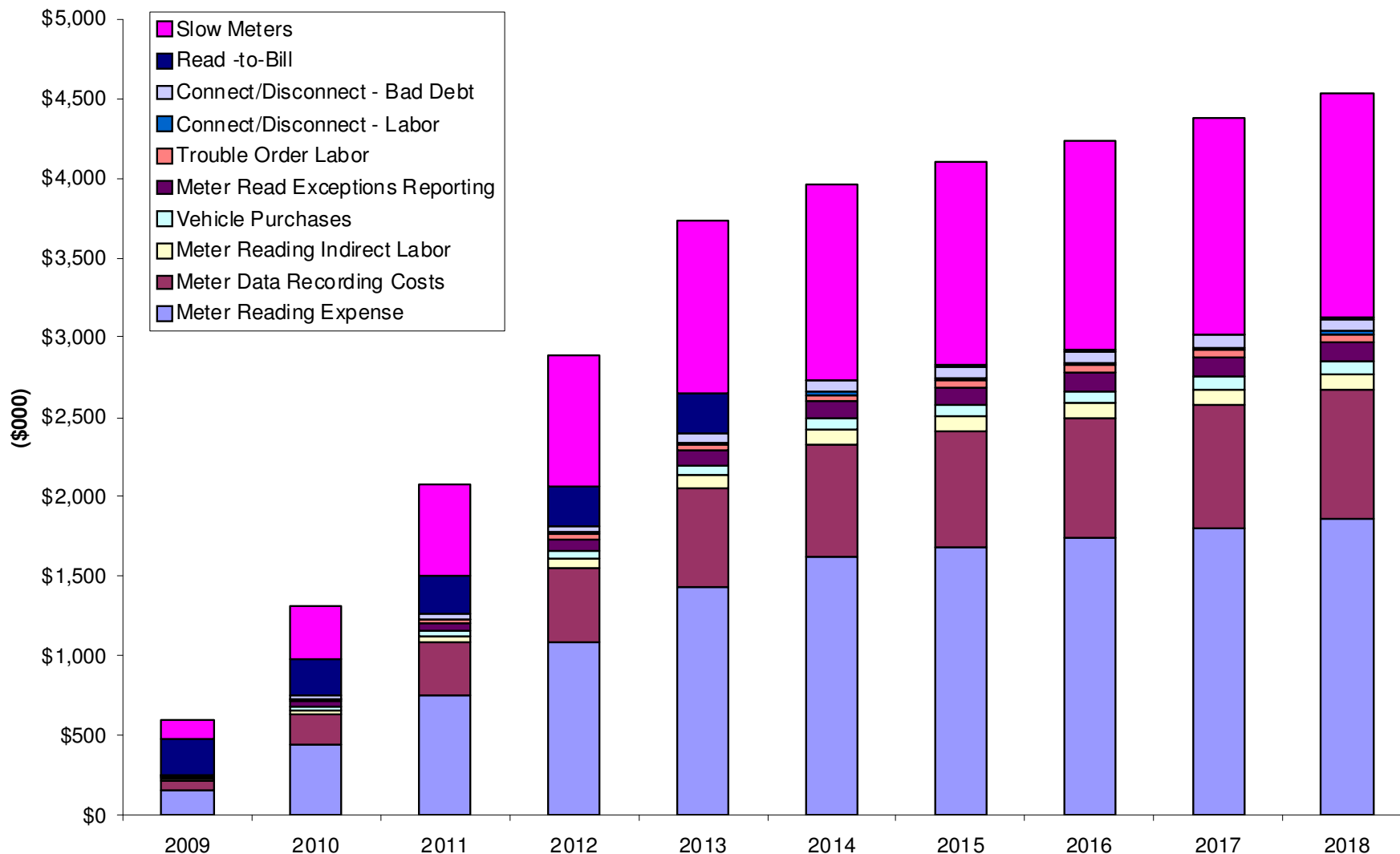
Total system benefits are geared to the specific nature of the utility and their operating characteristics in question

System Benefits



“Beyond the meter” applications offer greater benefits than simply reshaping meter reading

Metering Benefits



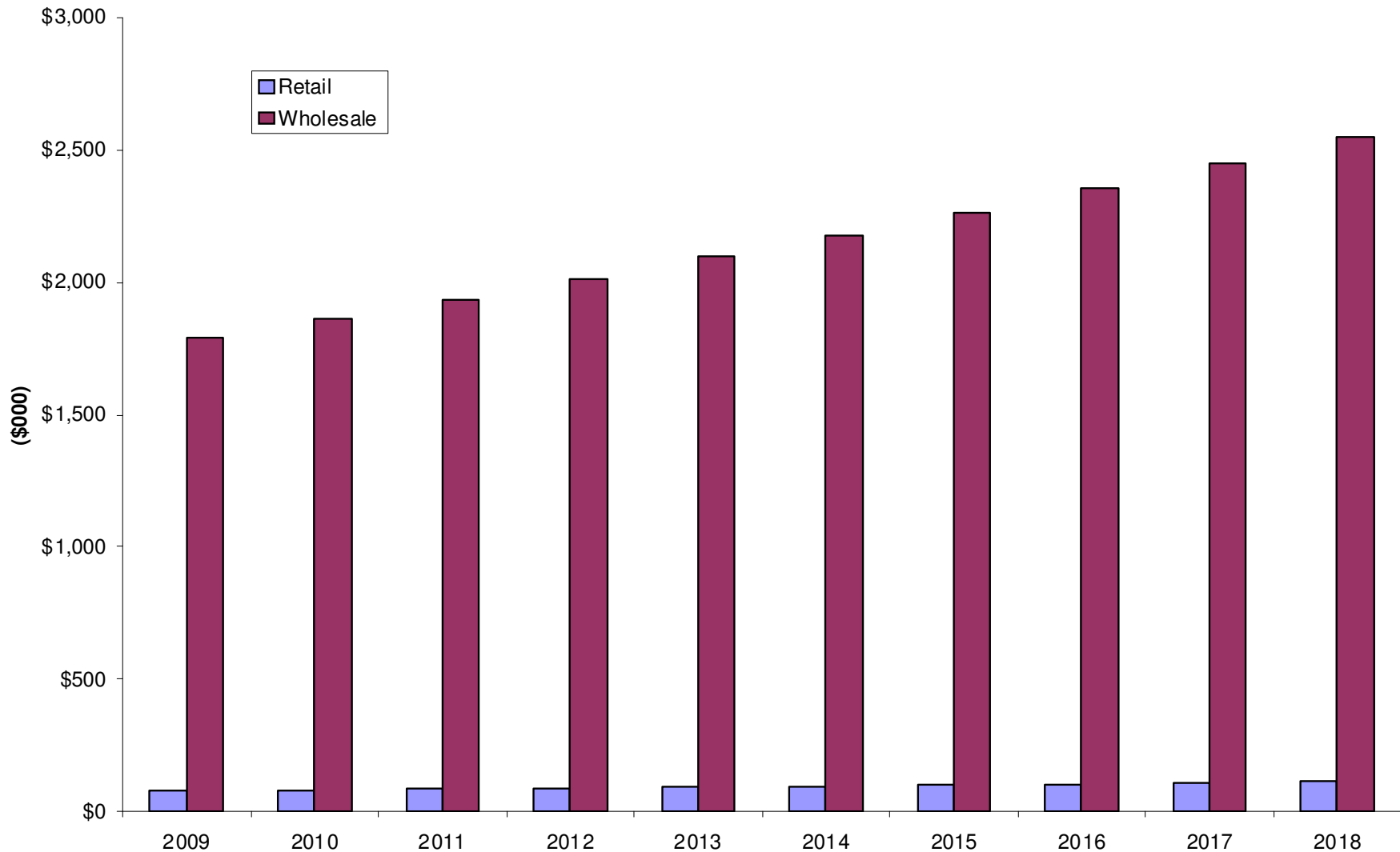
Distribution automation benefits that extend beyond metering can add substantial value to the business case with limited additional capital

Operations Benefits



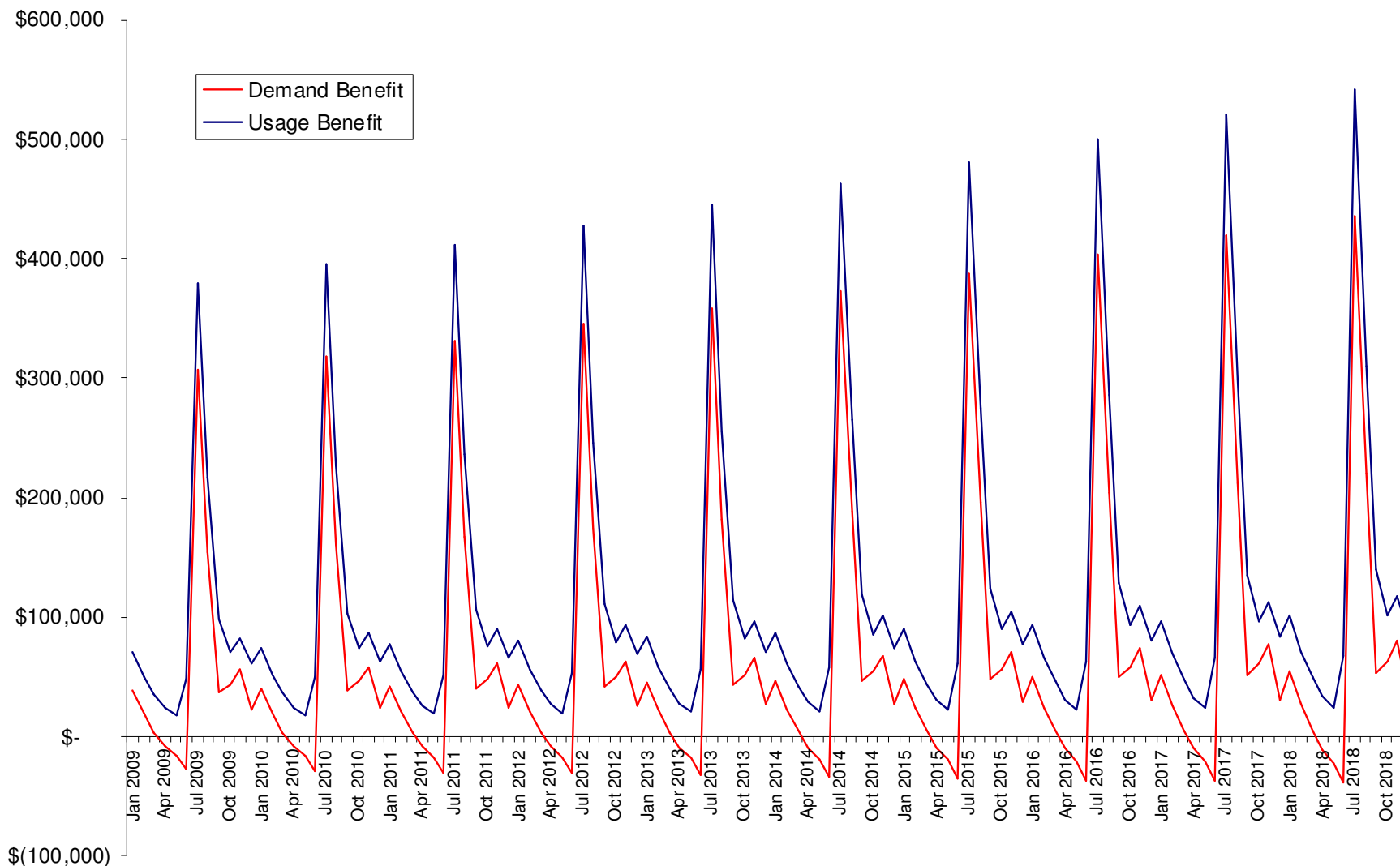
Opportunities to generate value in demand response with a smart grid architecture can be quite large

Demand Response Benefits



As expected, the benefits behind wholesale demand response are seasonal in nature, with the majority of the benefits occurring during the peak season

Wholesale Demand Response Benefits



There exists a gap between today’s initiatives and Smart Grid expectations; this gap can be removed through the development of a smart grid vision and plan with integration of the present projects and initiatives

- Planning for all areas needs to adopt a long range Smart grid flavor
- It is critical to coordinate the Smart Grid vision with communications and IT planning and initiatives



- | | | | | |
|---|---|--|---|---|
| <ul style="list-style-type: none"> • Develop senior level team • Define funding strategy • Define metric improvement • Test plan with external stakeholders | <ul style="list-style-type: none"> • Team for each functional area • Define short and long term plans • Review present initiatives to plan • Define metrics and expense/ cost estimates | <ul style="list-style-type: none"> • Define external needs, software and hardware • Utilize modeling for business case • Establish schedule | <ul style="list-style-type: none"> • Review all present technologies for plan support • Review all data needs and bandwidth requirements • Develop a technology plan | <ul style="list-style-type: none"> • Develop short range plan • Develop planning model • Develop funding plan • Present smart grid roadmap plan to executives and board |
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Establishing a smart grid direction must come from senior management

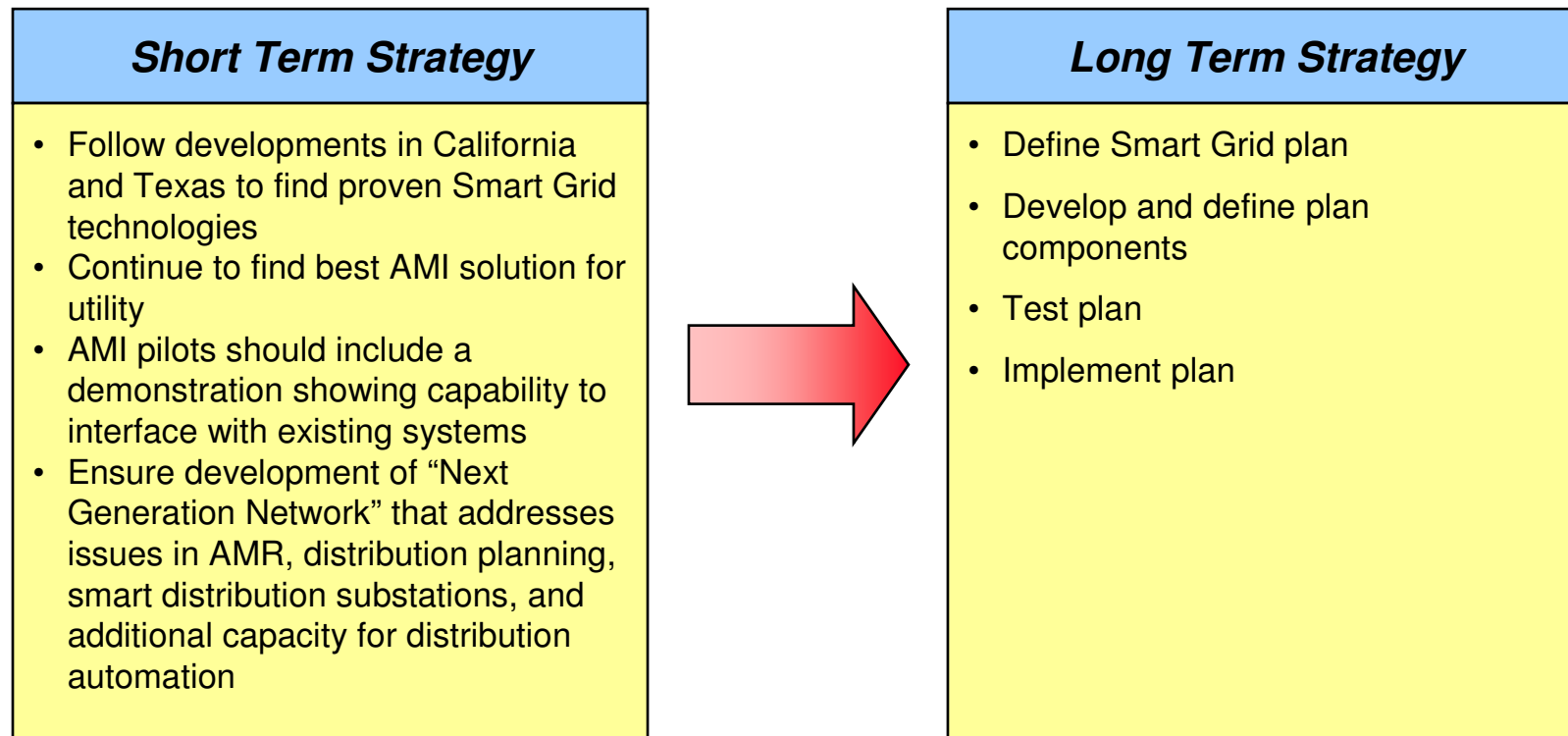
- Ultimately, the investment of a system can be substantial
 - Communications, distribution automation, and metering are the key cost drivers
 - Financial analysis will determine which applications/programs offer positive payback
- Timing appears to be favorable to establish and test a smart grid vision
 - The development of EAct 2005 is almost certain to drive the Commission to seek developments in this field
 - Advances in communications technology and interface devices suggest a stronger opportunity than has been seen previously
 - In addition, the aging workforce issue suggests an opportunity to act in the short term
- Utilities can seek areas of existing system stresses to determine the starting point for Smart Grid initiatives
 - Develop smart distribution subs
 - Expand substation and circuit capacity
 - Install DA on new circuits
 - Install communication and AMR equipment
- Regulators should be supportive of such an initiative
 - States such as Texas and California are supportive of such initiatives and have shown ways in which Commissions can champion and/or support positive company efforts

The other option is to wait for other utilities to push the development of Smart Grid

- While the upside is cost containment, the downside is much greater
 - Smart Grid is a 20 year undertaking for a utility and catching up to others will be difficult
 - The components of Smart Grid DA, AMR, DSM, DG are the only sustainable way to make performance improvements in reliability and customer service
- There is an advantage to being a first mover with regulators
 - By entering into positive efforts now, there exists an opportunity to educate regulators on the utility's schedule
 - Initial efforts can allow for the establishment of a funding plan and can offer rate certainty before full scale deployment
 - Developing a sound business case based on real costs and savings and performance improvement can be developed in support of rate relief

Industry movements dictate that short-term and long-term smart grid strategies must cater towards the salient needs and funding capabilities of the utility at hand

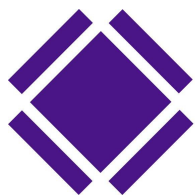
- Even with budget constraints, tough regulatory environments, and existing system demands, there are a number of steps that can be taken
- Positive early actions can lead to a viable long-term approach



There are a number of things to keep in mind when developing the smart grid business case

- Work with subject matter experts to drill down to real operating characteristics that drive economics
- Avoid using averages or unit values that do not tie to real economic benefit
- Develop financial models that allow you to see different scenarios
- Run sensitivity tests to look at valuation ranges rather than absolute values
- Validate assumptions through market research and analysis
- Determine which are the most critical cost items to control and work to get cost certainty around them

Questions?



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