ENERGY STORAGE AND THE NEXT GENERATION UTILITY

A STRATEGY GUIDE FOR THE FUTURE

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INTRODUCTION

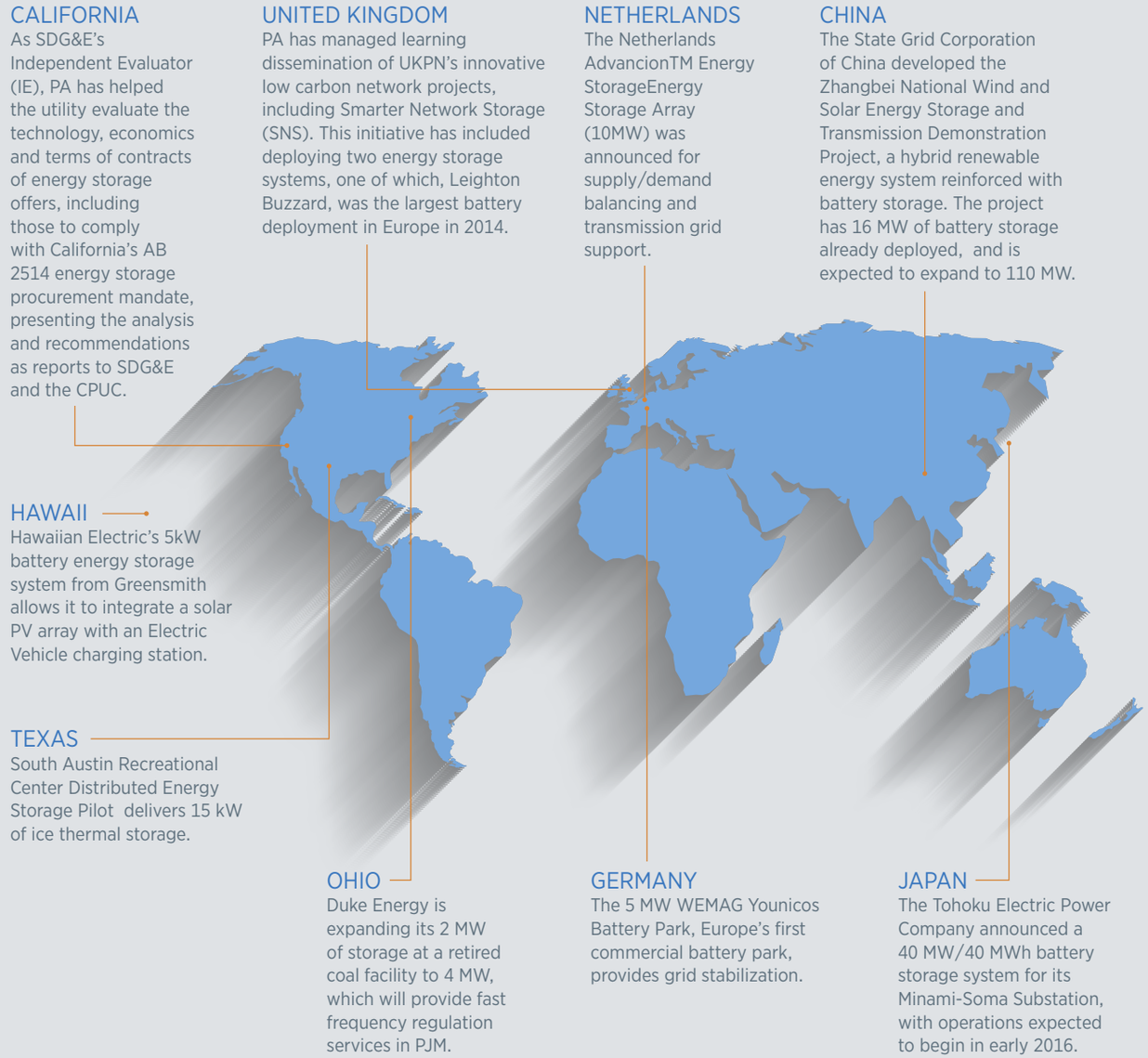
Storage and the next generation utility—a strategy guide for the future

Throughout the world, energy storage technologies are at a turning point. They are becoming more flexible, efficient and capable of reliably delivering energy to consumers, as needed. They are also playing a pivotal role in the growth of renewable energy and distributed energy resources. As technology costs decline and efficiency improves, we expect to see this market expand rapidly over a short period of time. For example, GTM Research expects the US Energy Storage annual market of deployments to rise fourfold from approximately 220 MW in 2015 to 858 MW in 2019.

If power utilities are to take advantage of this trend, they will require a cross-functional and well-defined enterprise strategy. Accordingly, PA Consulting Group (PA) has developed a cross-functional framework expressly designed to help utilities navigate the considerable uncertainties of adopting new technologies and gain real advantage in the industry.

This guide examines all the major aspects of a utility's storage deployment lifecycle. It highlights critical future impacts and suggested strategies across four functional utility groups:

- **Finance & Regulatory**
- **System Planning & Operations**
- **Advanced Technology & IT**
- **Customer Operations**



THE RISE OF ENERGY STORAGE
Driving forces

Emerging Business Models

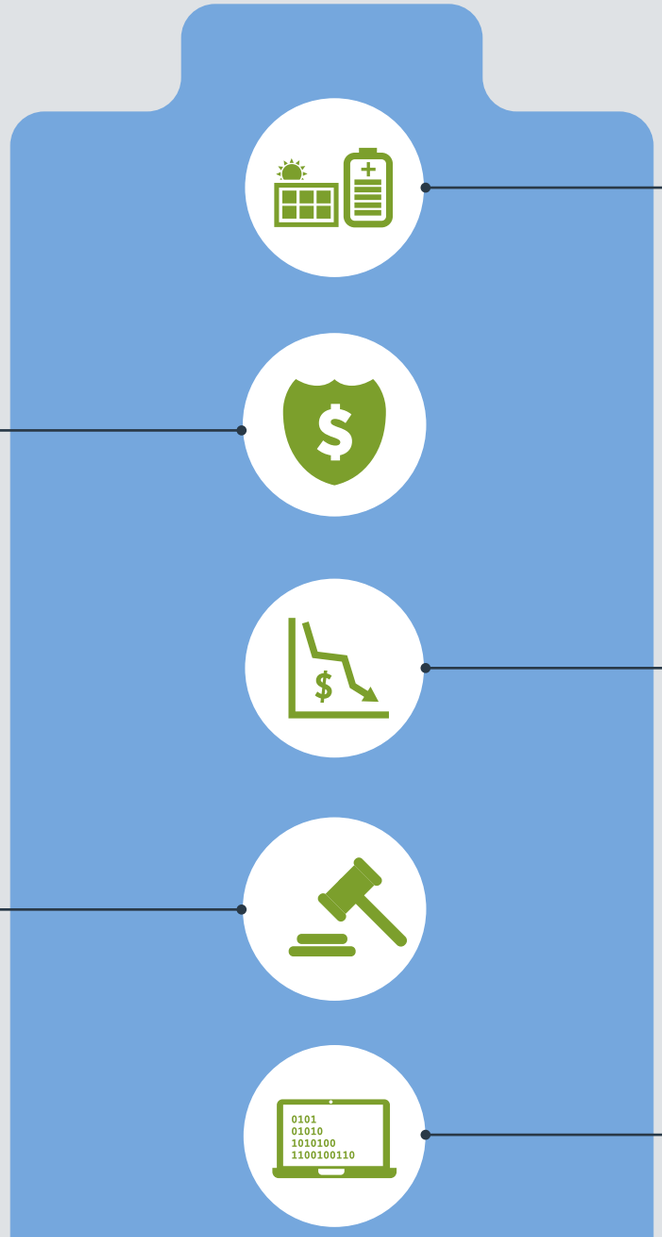
It is becoming clear that an evolution in the electric utility business model is in the making. The traditional cost-of-service utility business model, primarily based upon the sales of kilowatt-hours to pay for investments in the grid, is being challenged by a number of emerging trends. These include: flat or declining load growth, the proliferation of distributed energy resources, increasingly ambitious state renewable and energy efficiency goals and a rising appreciation for cleaner generation.

In addition, groundbreaking business model challenges such as New York State's Reforming Energy Vision, E.ON's split of its generation and distribution business and NRG's spin-off into a dedicated "GreenCo" business, are causing electric utilities, competitive generation owners, system providers, regulators and legislators to question how the traditional utility model should evolve.

A Changing Regulatory Environment

Regulation emerging in jurisdictions and markets across the United States, Germany and Australia require utilities to examine or, in some cases, mandate the adoption of storage.

Recent initiatives such as Reforming the Energy Vision (NY), AB 2514 (CA) and the Final Proposal on Distributed Energy Resource Providers (California Independent System Operators) have all proposed changes which would allow utilities to unlock and be compensated for adopting energy storage, partly overcoming the difficulties in quantifying and realizing its benefits.



Distributed Energy Resources + Storage

The meteoric growth of distributed energy resources (DER)—photovoltaics (PV) in particular—presents distribution utilities with both challenges and opportunities. From a planning perspective, capacity and reliability contributions are typically heavily discounted compared to dispatch resources. Storage has the potential to transform intermittent resources like solar PV into one of many assets in the utility's portfolio to meet and improve reliability.

In October 2015, NextEra Energy CEO Jim Robo said he expects energy storage to begin to replace gas-peaking plants after 2020.

Declining Costs and Technology Commercialization

Driven by a combination of increasing demand and economies-of-scale from adjacent industries (e.g. electric vehicles), the cost of energy storage—battery storage in particular—has declined precipitously over the past several years.

The cost of lithium-ion batteries dropped from 1400 $/kWh in 2010 to 500 $/kWh in 2014, or by 64%. The total installed cost of a commercial 2 to 4 hour lithium-ion energy storage system dropped from 3400 $/kWh in 2010 to 1600 $/kWh in 2014. Furthermore, strategic partnerships and an influx of corporate venture capital from companies such as NRG, RWE and GE are helping to commercialize emerging technologies.

Source: GTM Research

Intelligent Grid Infrastructure

The pervasive adoption and use of intelligent electronic devices and sensors is generating massive volumes of data which has allowed utilities to operate the grid more cost-effectively and reliably. Energy storage is no exception to this trend.

Intelligent software solutions enable greater flexibility in determining the most cost-effective and beneficial times to discharge the storage device. At the end of 2007, seven million smart meters had been installed in the USA. By mid-2014, installations reached 50 million, accounting for approximately 43% of all US homes.

Source: Edison Foundation

PA'S ENERGY STORAGE DEPLOYMENT LIFE-CYCLE

MARKET, TECHNOLOGY AND POLICY SCAN

- Evaluation of current storage penetration in service territory
- Energy storage systems (ESS) technology evaluation
- Vendor eco-system research and comparative analysis
- Identification of strategic partnership opportunities
- PA's FutureWorlds Scenario Planning

- Integrated resource planning
- Power system production cost modeling
- Base case and sensitivity analysis
- Use case identification
- Organizational capability assessment for storage-impacted groups

- Use case and "best fit" technology matching across value chain and possible applications
- Feasibility analysis
- Translation of use cases to business requirements

- Energy storage cost/benefit analysis
- Rate impact and revenue requirement analysis
- Regulatory accounting and cost allocation
- Regulatory filing development

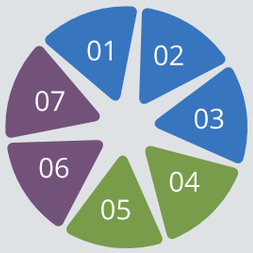
- RFP development
- Bid evaluation and vendor selection
- External stakeholder engagement
- Strategic sourcing
- Go-to market strategy for new C&I and residential storage services

- ESS hardware and software system design, development, and deployment
- Site Selection/Civil Engineering
- Permitting
- Project and vendor management
- Safety/environmental

- Organizational impact analysis and change management
- Customer care and proactive communication
- Stakeholder outreach
- Transition to operations
- Analytics & system performance optimization
- Business intelligence and process improvement

ENERGY STORAGE CROSS-FUNCTIONAL FRAMEWORK

Strategic considerations across utility functions



Deployment life-cycle

Market, policy and technology scan

01 Operational needs assessment

02 Use case and technology pairing

03 Business case and cost allocation

04 Planning and procurement

05 Design and installation

06 Business integration

07 Optimization

DUE DILIGENCE AND PRE-IMPLEMENTATION | DEPLOYMENT | OPERATION

Summary of cross-functional framework

		DUE DILIGENCE AND PRE-IMPLEMENTATION	DEPLOYMENT	OPERATION
Finance & Regulatory		• Monitor all asset financing methods • Monitor positive/negative impact on financing elicited by new market rules & regulations • Evaluate economic feasibility of proposed solutions, and potential cost-sharing with third-party/customers • Obtain regulatory approval — HIGH	• Ensure full economic benefits capture for regulatory reporting purposes and fair benefit-cost allocation between all parties involved — MEDIUM	• Hedge against market/regulatory risk during operation • Create tools & mechanisms to track new O&M for storage — LOW
System Planning & Operations		• Monitor need for peak shaving • Monitor system need for more regulation services due to generation profile change & intermittency • Evaluate interconnection challenges — MEDIUM	• Assess operational life of storage devices and impact on O&M costs • Understand deferred system costs to support expected value streams — HIGH	• Ensure data-driven storage operation and dispatch decisions • Capture interconnection and operational benefits and lessons — HIGH
Advanced Technology and IT		• Monitor all vendor/third-party storage hardware & software innovation in the marketplace that enhance specific solutions — MEDIUM	• Be ready to integrate agreed storage solution with existing SCADA / IT control systems • Be ready to integrate with behind-the-meter systems — HIGH	• Ensure robust data analytics and management to support more real-time operations • Enable data sharing and verification with customer and regulators — MEDIUM
Customer Operations		• Monitor customer behind-meter storage adoption and risks to system • Monitor behind-meter aggregated storage possibilities to address system needs, especially commercial & industrial (C&I)	• Manage any impacts to existing customer rates/ business model • Develop new contractual partnerships in solution integration and deployment with customer	• Deploy storage management solutions to enhance transaction between grid and customer needs • Enhance customer services to maximize benefits of utility-customer storage partnership

IMPACT:

HIGH

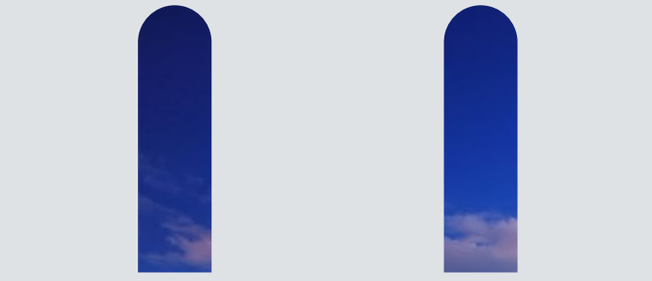
MEDIUM

LOW

FINANCE AND REGULATORY

Key trends

- Evolving energy markets and regulations are challenging traditional methods of valuing storage assets
- Increased deployment of storage assets is affecting the value of legacy investments and existing infrastructure
- Adoption of storage assets is adding complexity to the accurate projection of asset reliability and lifespan



Deployment life-cycle

Market, policy and technology scan

DUE DILIGENCE AND PRE-IMPLEMENTATION

01 Operational needs assessment

- Ensure all asset financing options are identified
- Conduct due diligence on market reforms, incentives, tax credits or other legislation
- Check and compare vendor offers
- Consult comparable organizations on best practice and lessons learned
- Quantify the value of storage to customers and to shareholders based on the expected benefits from storage
- Evaluate the cost-benefit allocations between the utility and customer for customer-sited/ behind-the-meter storage
- Obtain regulatory approval

02 Use case and technology pairing

03 Business case and cost allocation

DEPLOYMENT

04 Planning and procurement

- Capture relevant data for value analysis and regulatory reporting
- Design new methods for calculating operational costs and benefits for each storage use alternative
- Design new methods of capturing customer-specific benefits

05 Design and installation

OPERATION

06 Business integration

- Evaluate cost trajectory as installed components degrade and vendor services evolve
- Track capacity and ramping tariffs over assets' lifetime to determine payback
- Ensure risks are managed in energy arbitrage applications, and are properly hedged

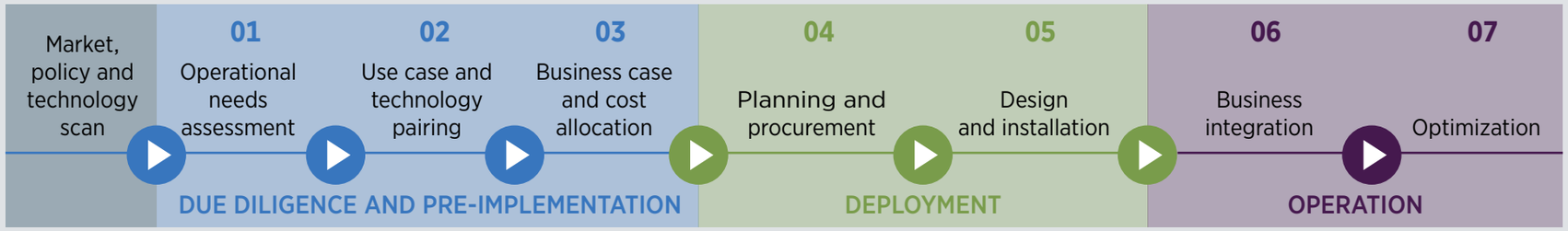
07 Optimization

SYSTEM PLANNING & OPERATIONS

Key trends

- System designed to be efficient throughout the year, rather than to provide peak reliability
- Revamped operations to incorporate the increasingly granular consumption data and optimize the interconnection and dispatch of distributed energy resources
- Operational need for regulation is increasing as more intermittent resources replace larger, emissions-constrained units.

Deployment life-cycle



DUE DILIGENCE AND PRE-IMPLEMENTATION

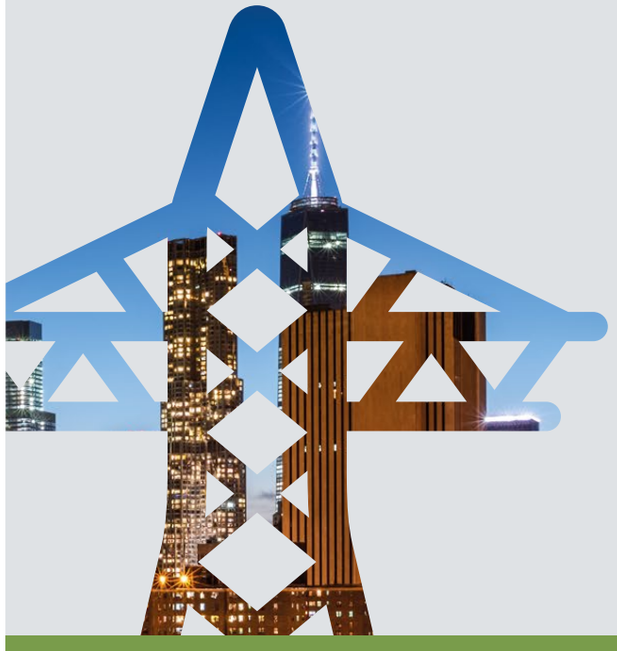
- Determine number of peak hours that can be shaved by storage projects
- Update contingency scenarios to include sudden loss of intermittent resources over a large area
- Evaluate interconnection and licensing criteria
- Assess impact on thermal, voltage, short circuit, transient over voltage, frequency stability and other system planning requirements.
- Determine and calculate the expected benefits from storage, including metrics such as enhanced reliability and clean energy.

DEPLOYMENT

- Determine the Equivalent Availability Factor (EAF) calculation/assumption
- Determine the expected operational life of the storage device
- Calculate the value of deferred infrastructure and revised regulations
- Analyze how value streams will change with additional storage

OPERATION

- Leverage increased market, grid and asset data to optimize dispatch decisions
- Update interconnection criteria and threshold levels for deploying standardized designs or solutions
- Verify and update assumptions applied during planning phase



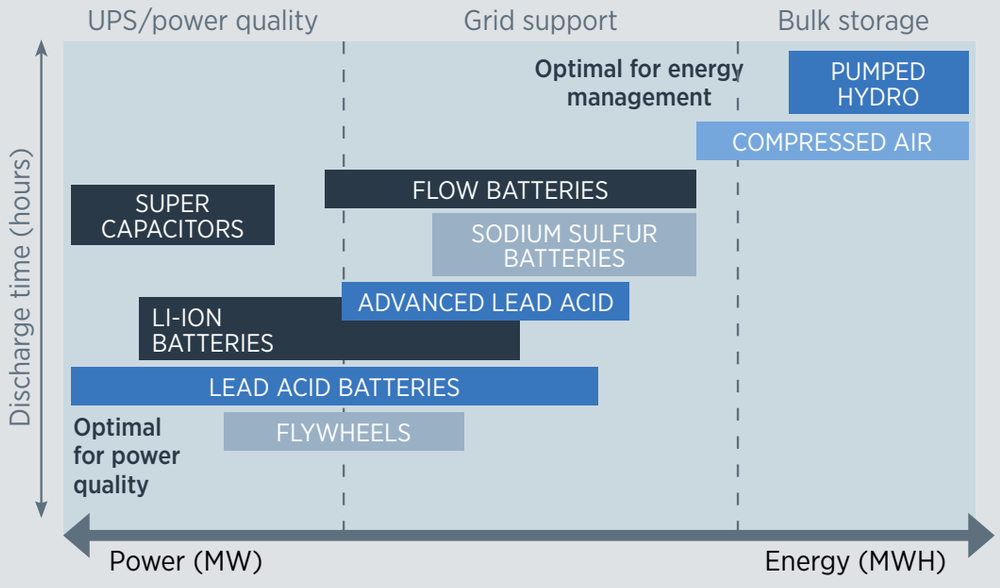


FIGURE 1: DIFFERENT STORAGE TECHNOLOGIES MEET DIFFERENT NEEDS OF THE ELECTRICAL SYSTEM

Planning & Operations groups have to work closer with each other to determine the most valuable storage projects and operating models.

Analysis will require support from the utility's data management, IT and OT teams.

ADVANCED TECHNOLOGY & IT

Key trends

- The convergence of information and operational technology are facilitating adoption of energy storage solutions
- New technologies are quickly developing scalable modular system design, integrating battery management and legacy systems, centralizing dispatch of distributed resources and more
- The industry is working to define new standards for storage vendor components and communications protocols

Deployment life-cycle

Market, policy and technology scan	01 Operational needs assessment	02 Use case and technology pairing	03 Business case and cost allocation	04 Planning and procurement	05 Design and installation	06 Business integration	07 Optimization
	DUE DILIGENCE AND PRE-IMPLEMENTATION			DEPLOYMENT		OPERATION	

- Develop a firm understanding of existing vendor alternatives
- Determine the technologies and solutions that can be paired with the intended applications
- Analyze how storage assets and control systems will integrate with the utility's IT architecture
- Develop proactive measures to prevent storage asset from becoming "stranded"

- Create clear governance structure across business units for storage/IT decision-making
- Align storage alternatives and operational criteria to business requirements and system specifications
- Ensure integration with behind-the-meter IT/control systems
- Evaluate organizational and system integration impacts on operations (SCADA, OMS, ADMS, DERMS); customer (CIS, CRM); and finance

- Assess and address change management and training needs
- Incorporate advanced data analytics into energy storage operations
- Initiate measurement and verification methodology and technology to ensure operational efficiency and regulatory compliance
- Consider the implementation of a distributed energy resource management system
- Incorporate lessons learned in future strategic planning activities

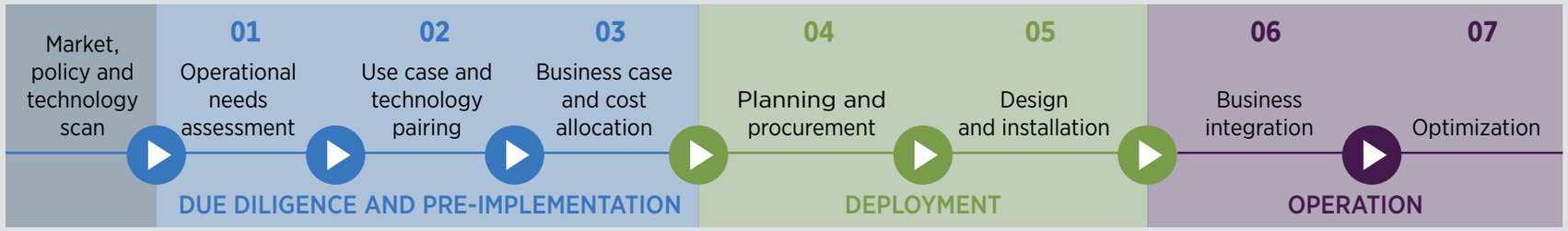
CUSTOMER OPERATIONS

Key trends

- The importance of real understanding and involvement of customers in storage deployment is key
- Behind-the-meter storage is rapidly becoming a high-value service proposition for the sector
- Third-party storage solutions such as Tesla's PowerWall and PowerPack are gaining ground in mainstream sectors
- Utilities are creating new business models and revenue streams from customer-sited distributed energy resources




Deployment life-cycle



- Assess market to determine current penetration/interest in storage
- Identify where behind-the-meter storage could have locational value
- Identify competitors and/or strategic partners active in the market and understand the technical and economic value they deliver

- Define capabilities and processes for outreach, acquisition, contracting, interconnection and installation
- Build business case for distributed storage that considers customer rate impacts
- Develop compelling customer benefits message for regulatory communications
- Complete segmentation for all customer groups

- Enhance contact center processes, roles and technology platforms to support customer storage assets and complex account data
- Apply customer analytics to evaluate load profiles and the value of distributed storage
- Perform analysis of customer storage and demand response programs for continuous improvement and regulatory reporting

Choosing the right storage strategy for a Next Generation Utility requires a cross-functional enterprise approach across the deployment life-cycle

Each stakeholder group will bring their unique competencies to the process of evaluating, deploying and operating a chosen storage strategy. Utilities that are most effective in deploying storage solutions, however, do so by bringing the most impacted and pivotal stakeholders together to integrate new and existing technologies and distributed energy resources into core operations. Informed and integrated enterprise approaches are the hallmark of a successful Next Generation Utility strategy.

The Next Generation Utility

Utilities have historically struggled to implement new technologies at scale and in an accelerated manner. Indeed, PA's landmark Innovation survey and report "Innovation as Unusual (2015)" found that nearly half of the survey respondents from the energy industry believe that they lack the skills necessary to make innovation happen and roll out new technologies across their business.

At PA, we consistently track emerging energy business models, distributed energy resource deployment strategies, technology commercialization, intelligent grid infrastructure deployments and the rapidly changing regulatory environment. For each of these domains, in addition to this paper's four utility function areas as related to storage, PA has assembled subject matter experts to provide an end-to-end view of the impacts and required strategies required to become a Next Generation Utility.

We have worked with clients globally across the energy storage deployment lifecycle, including investor-owned utilities, public utilities, third-party investors, independent system operators and DER providers. We provide consulting services regularly in the areas of strategic planning, independent evaluation, vendor management and market advisory.

ENERGY STORAGE AND THE NEXT GENERATION UTILITY

Use our expertise

PA Consulting Group works with energy and water companies, offering deep sector insight and providing solutions to a wide range of challenges, including improving reliability, enhancing the performance of critical processes, and delivering IT integration. PA can help utilities realize the benefits of digital technologies across the value chain to optimize performance, customer service and, of course, safety and reliability.

For more information on how we can help your utility undergo the transformation to a next generation utility, please contact us at **energy@paconsulting.com**

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