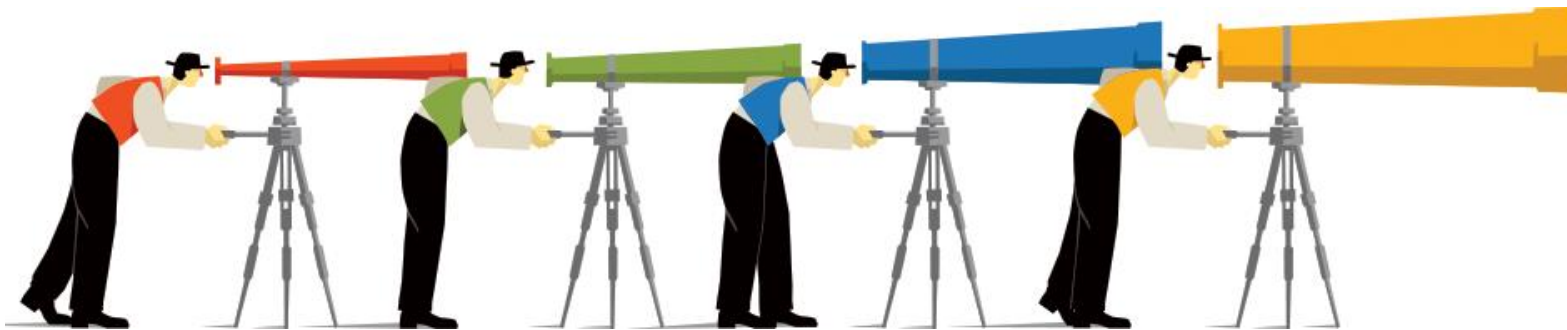


## Smart Grid Regional Business Case (RBC) *Draft Final Results*



Brownbag

September 23, 2015





## **1 » Introduction**

2 » Overall Value of Smart Grid to the Pacific Northwest

3 » Findings from Investment Category Analysis

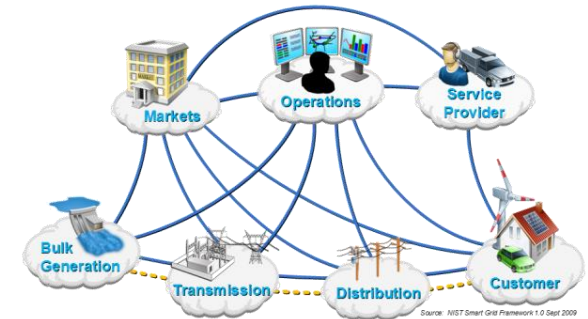
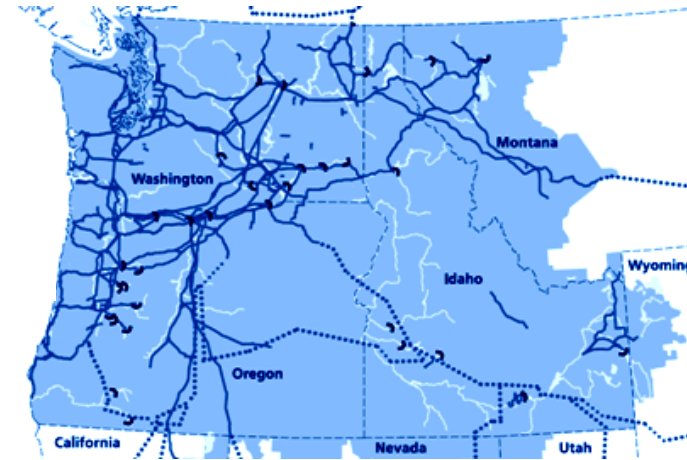
4 » Selected Smart Grid Capabilities of Interest

5 » Takeaways & Looking Forward

## Why a Regional Business Case (RBC) for Smart Grid?

### Problem Statement

- » The smart grid *promises many benefits* for the region
- » However, *benefits are uncertain*, and stakeholders have limited experience with many emerging technologies
- » What should Bonneville Power Administration (BPA) do in its role as a *regional steward* to help stakeholders understand value and minimize risks?
- » BPA developed the RBC to help guide regional stakeholders in making *appropriate investments* in smart technologies

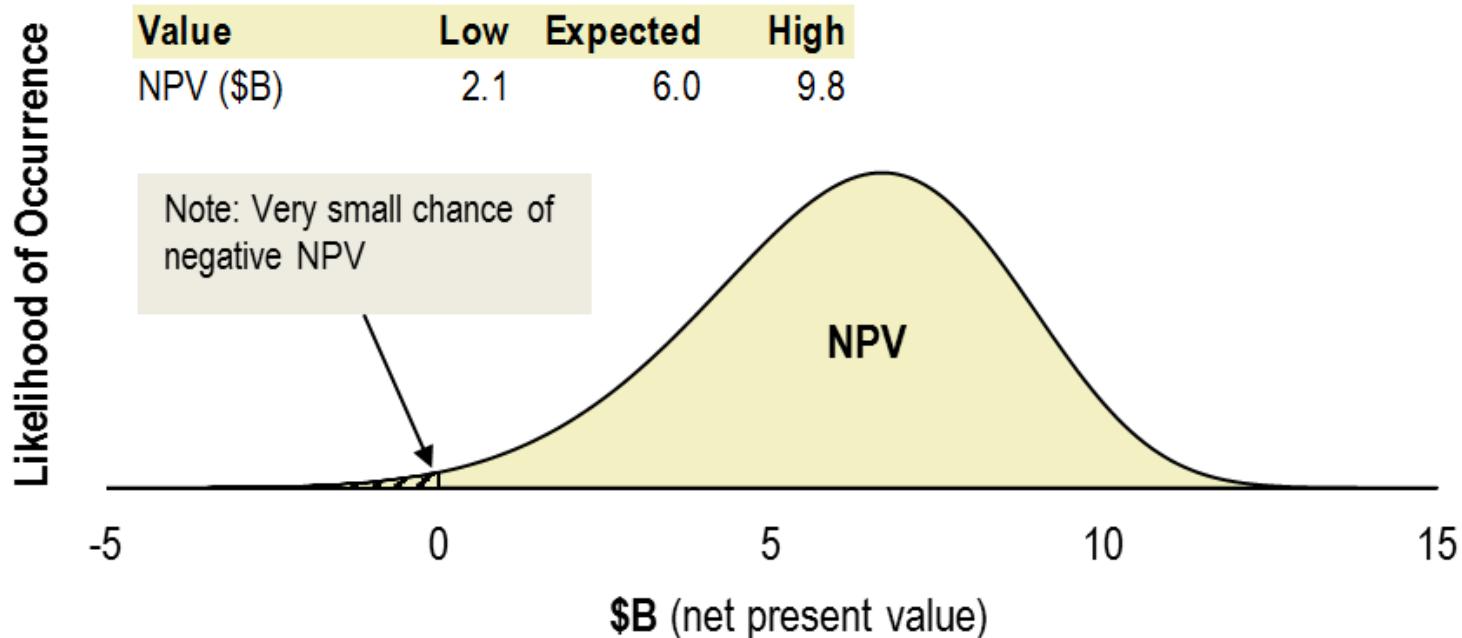


(Source: "NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 [Draft]," Office of the National Coordinator for Smart Grid Interoperability, NIST [September 2009].)

## Overall Smart Grid Investment Appears Quite Attractive for the Region

### Net Present Value of Smart Grid Investments

(Uncertainty Analysis Results)

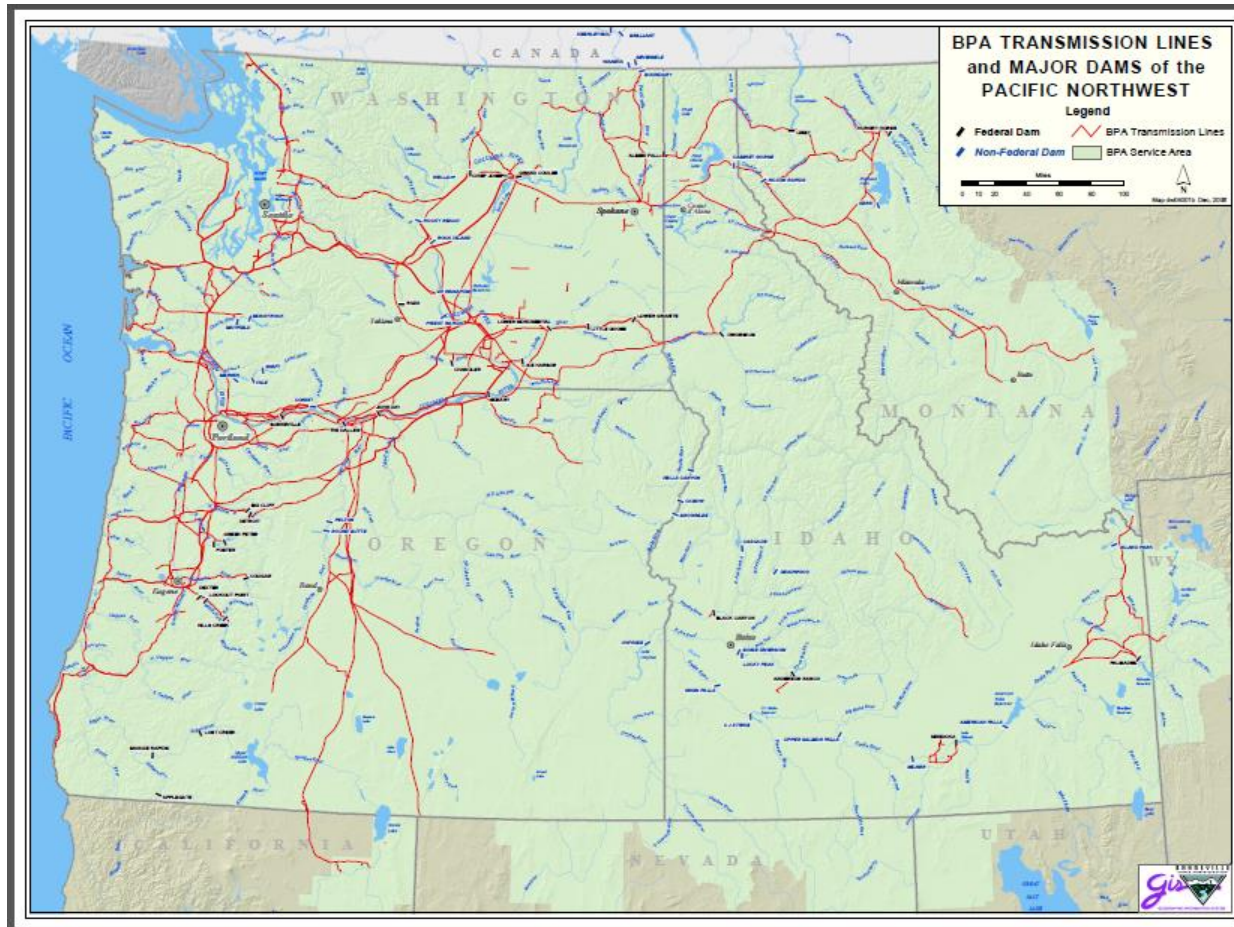


Source: Navigant Analysis

## Analysis Approach

- » **Defines Smart Grid as:**
  - *Two-way communications*
  - Some level of *automated intelligence*
- » **Considers Only Incremental Smart Grid Costs and Benefits**
  - Only benefits and costs that can be *attributed* to smart grid investments
  - Clear line between *smart grid* capabilities versus *traditional* capabilities
- » **Uses 30-Year Time Horizon**
  - Leverages available regional forecast data and projections
- » **Deploys Technology Based on Current Trends and Projections**
  - Investments from *2015 through 2044*
  - Includes *34 smart grid capabilities* spanning *six investment categories*
  - Deployment assumptions influenced by early success indications
- » **Leverages Uncertainty Analysis and Scenarios**
  - Help understand investment *risks* and key *directional outcomes*

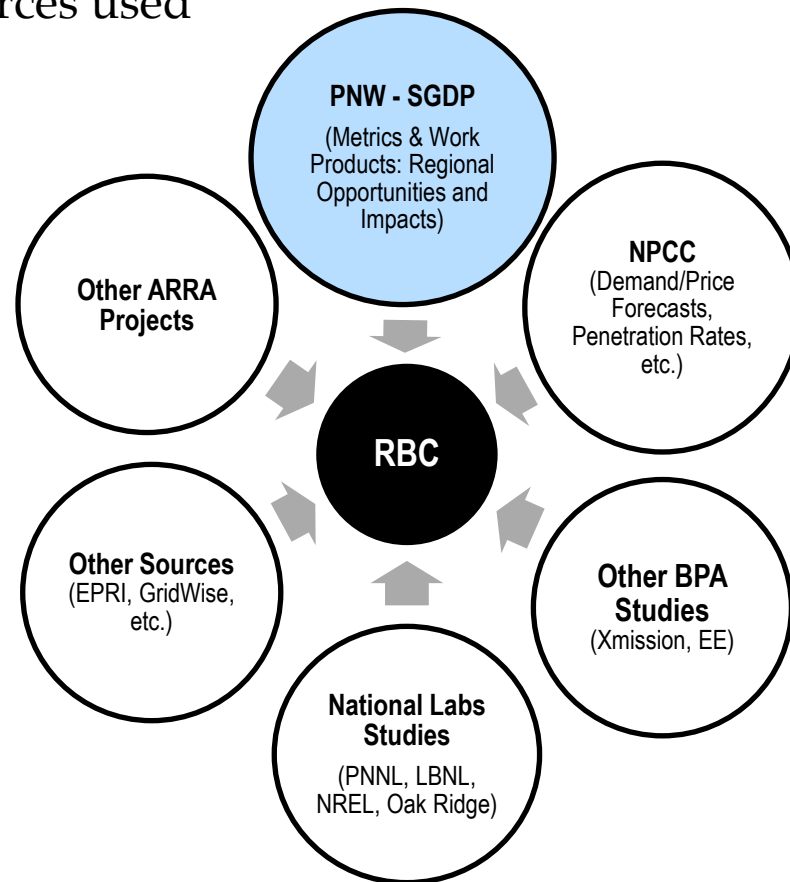
## Map of the Pacific Northwest (PNW) Region Considered in the RBC



(Source: [http://www.bpa.gov/news/pubs/maps/Tlines\\_Dams\\_SAB.pdf](http://www.bpa.gov/news/pubs/maps/Tlines_Dams_SAB.pdf).)

## The RBC Uses Input from a Wide Range of Sources

- » Goal: Use best available real-world data
- » Over 100 other sources used



# PNW Demonstration Project Relationship

## PNW Demonstration Project *Test Case* Data Used as Inputs to RBC Model

PNW SGDP Responsive Asset Types	# of Test Cases
Advanced Sensors / Meters	10
Energy Storage	7
Distributed Generator	5
Distributed Renewable Energy Resource	14
Distribution Automation / Reconfiguration	5
Load Management / Control	24
Meter Data Management System	6
Microgrid Management / Control	3
Power Factor Control	2
Voltage Control / Optimization	16

(Source: From Table 1.2 [p. 1.6] of PNW SGDP Metrics & Benefits Reporting Plan)

RBC Smart Grid Capabilities	IC*
Automated VAR Control	T&D Optimization
Smart Voltage Reduction (CVR & DVR)	
Dynamic Capacity Rating	
Automated Power Flow Control for Transmission	
Automated Real Time Load Transfer for Distribution	
Notification of T&D Equipment Condition	
Fault Current Limiting for T&D	
Distributed Energy Resource Monitoring & Control	
Centralized Renewable Resource Monitoring & Control	
Wide Area Monitoring	
Automated Islanding & Reconnection (Microgrid)	
Enhanced Fault Prevention for T&D	
Fault Location, Isolation & Service Restoration (FLISR)	Dynamic & Responsive Demand
Demand Response - Air Conditioning/Space Cooling	
Demand Response - Appliances & Plug Loads	
Demand Response - Lighting	
Demand Response - Refrigeration, Motors, & Process	
Demand Response - Space Heating	
Demand Response - Water Heating	
End Use Conservation	End Use EE
End Use Equipment Efficiency Upgrade	
Notification of End Use Equipment Condition	Grid Storage
Transmission-Sited Grid Storage Integration & Control	
Distribution-Sited Grid Storage Integration & Control	
Electric Vehicle Battery Integration & Control	Utility Op. Eff.
Automated AMI Meter Reading & Billing	
Improved DSM Program Execution (M&V, etc.)	
Improved Regional Planning & Forecasting	



\* IC = Investment Categories



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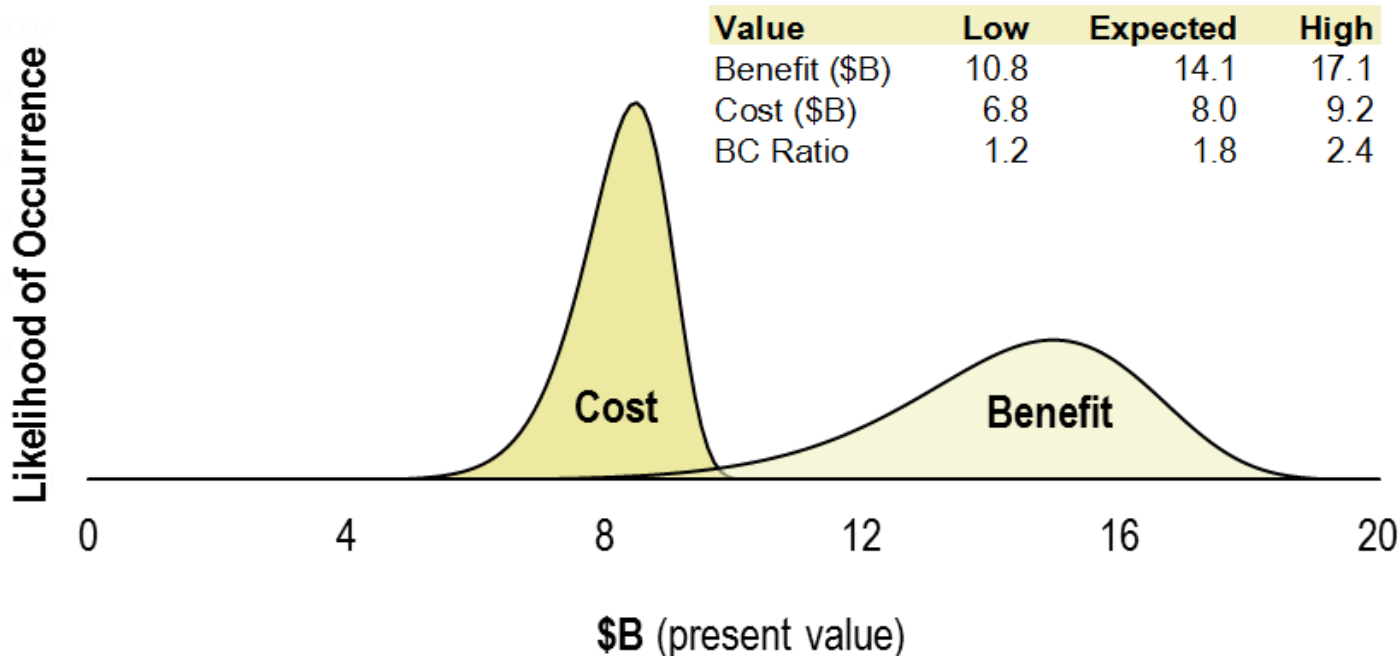
4 » Selected Smart Grid Capabilities of Interest

5 » Takeaways & Looking Forward

## Regional Benefits Expected to Outweigh Costs Significantly

### Present Value of Benefits and Costs

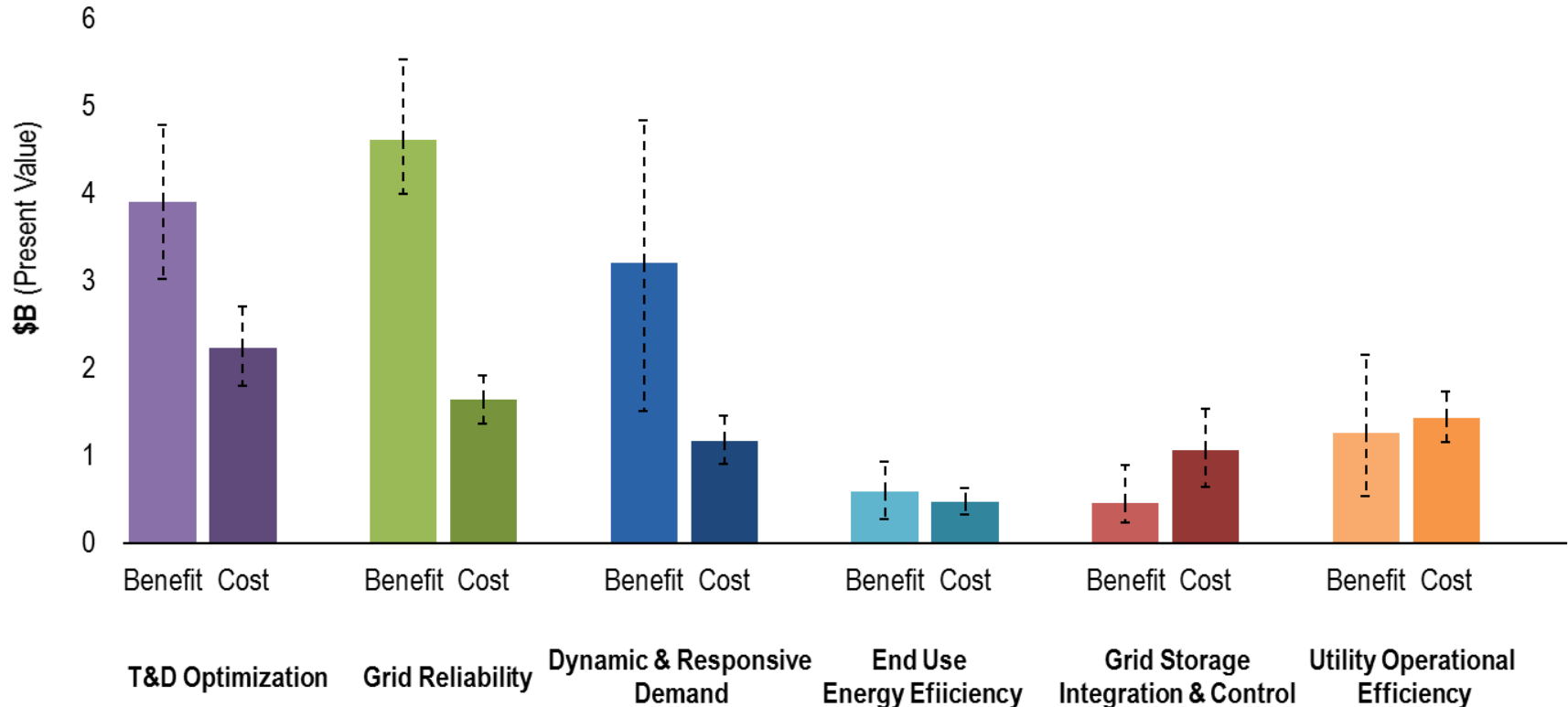
(Uncertainty Analysis Results)



Source: Navigant Analysis

## Six Investment Categories Show Different Returns and Risks

Present Value of Benefits and Costs by Investment Category



Source: Navigant Analysis

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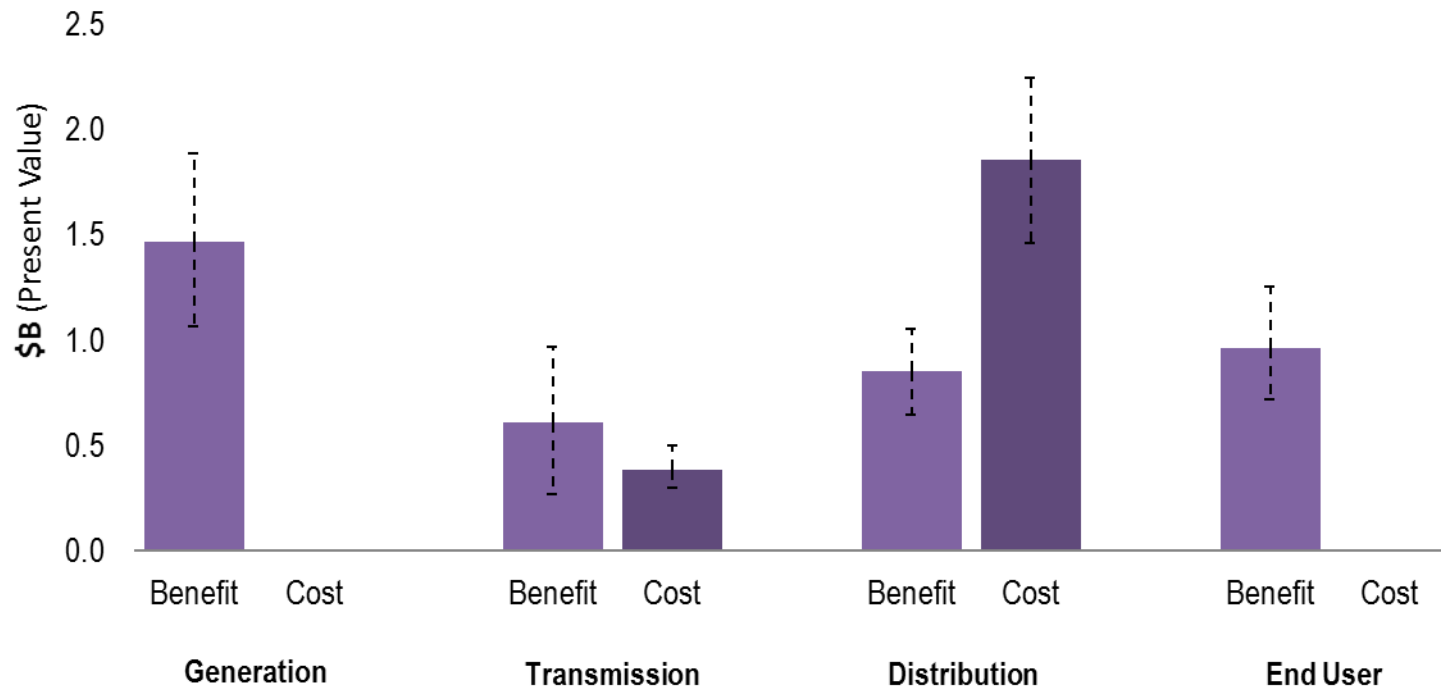
**3 » Findings from Investment Category Analysis**

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## Transmission and Distribution (T&D) Optimization Benefits Spread Across the Value Chain

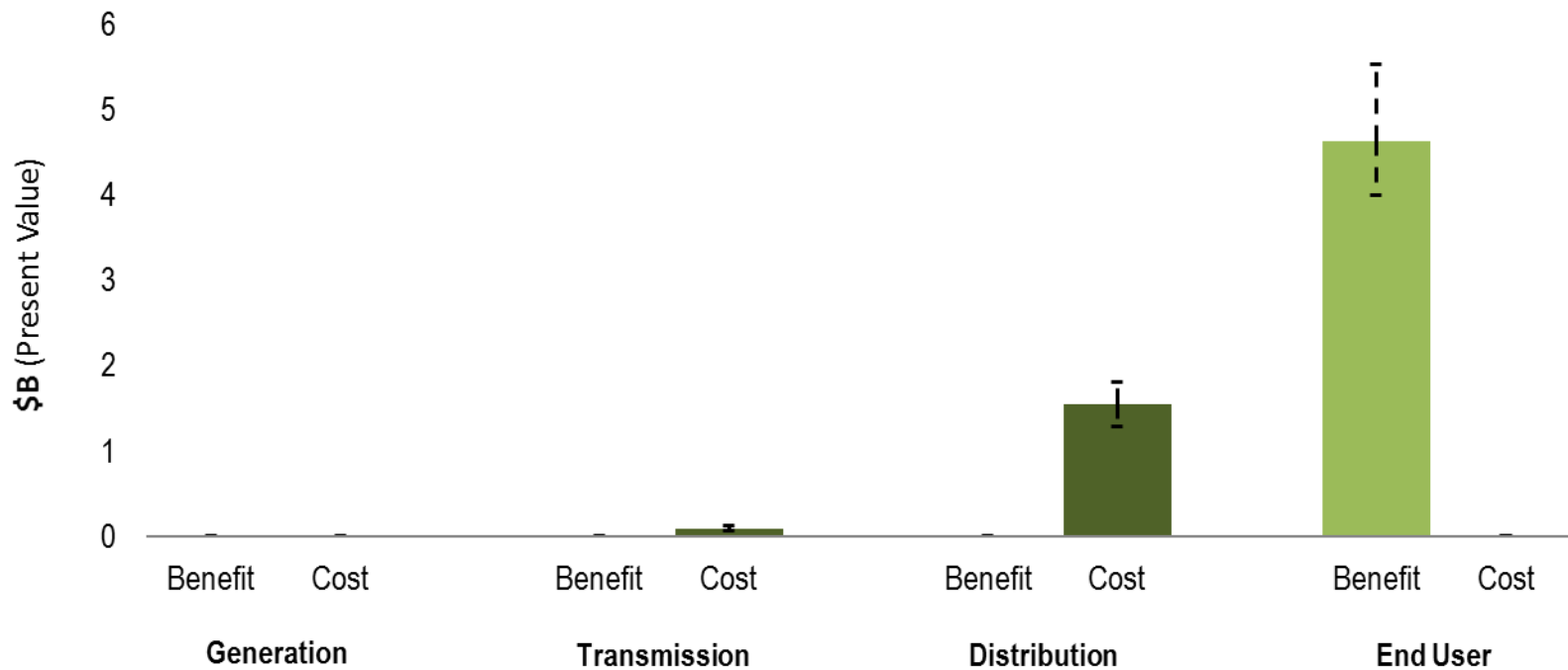
### T&D Optimization Benefits and Costs by Stakeholder Perspective



Source: Navigant Analysis

## Grid Reliability Benefits Accrue Almost Entirely to End Users

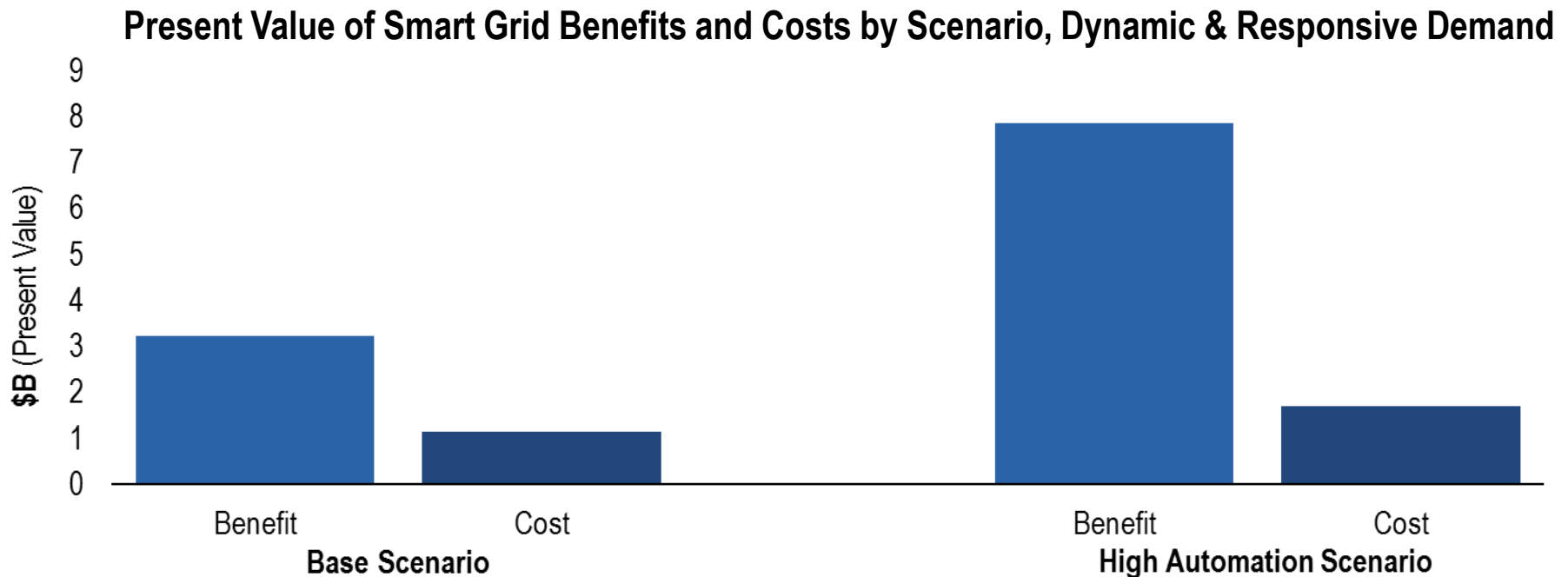
### Grid Reliability Benefits and Costs by Stakeholder Perspective



Source: Navigant Analysis

## Dynamic and Responsive Demand Highly Beneficial, but High Uncertainty

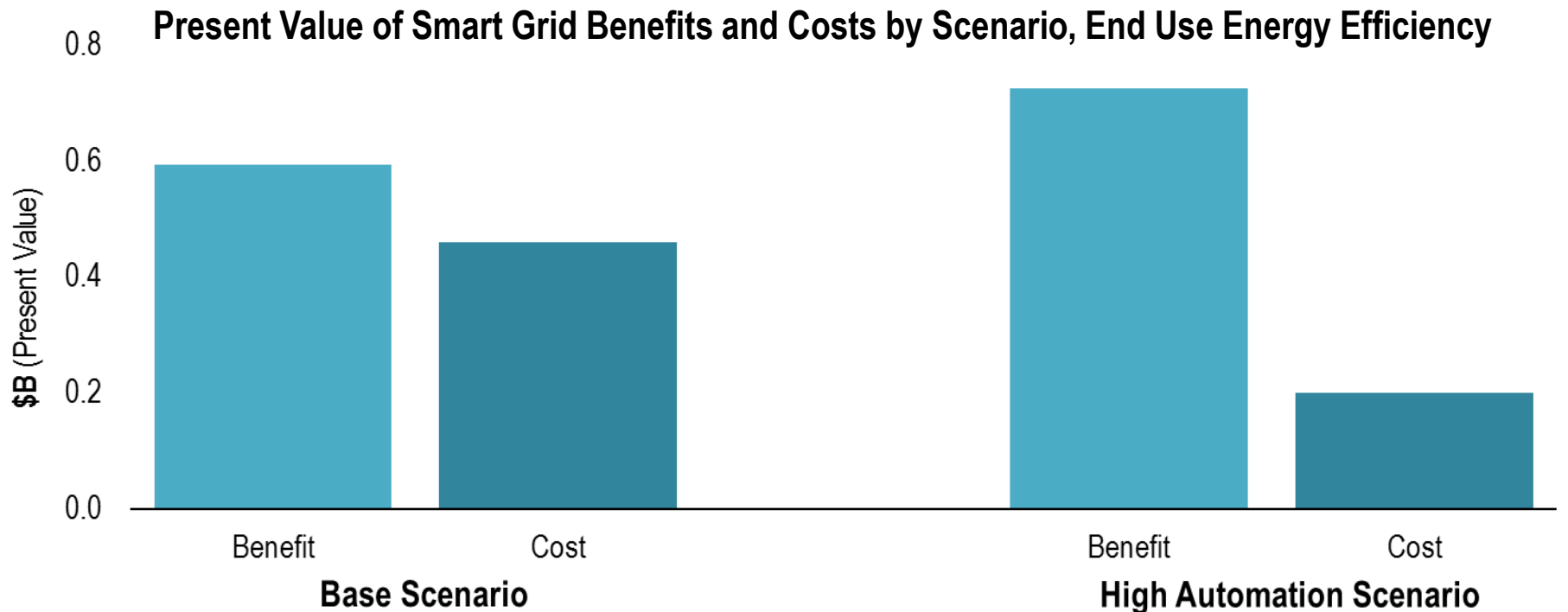
» Increased Home and Building Automation Scenario would boost results



Source: Navigant Analysis

## End-Use Energy Efficiency Smart Grid Impact Can Provide Benefit

» Increased Home and Building Automation Scenario would improve results



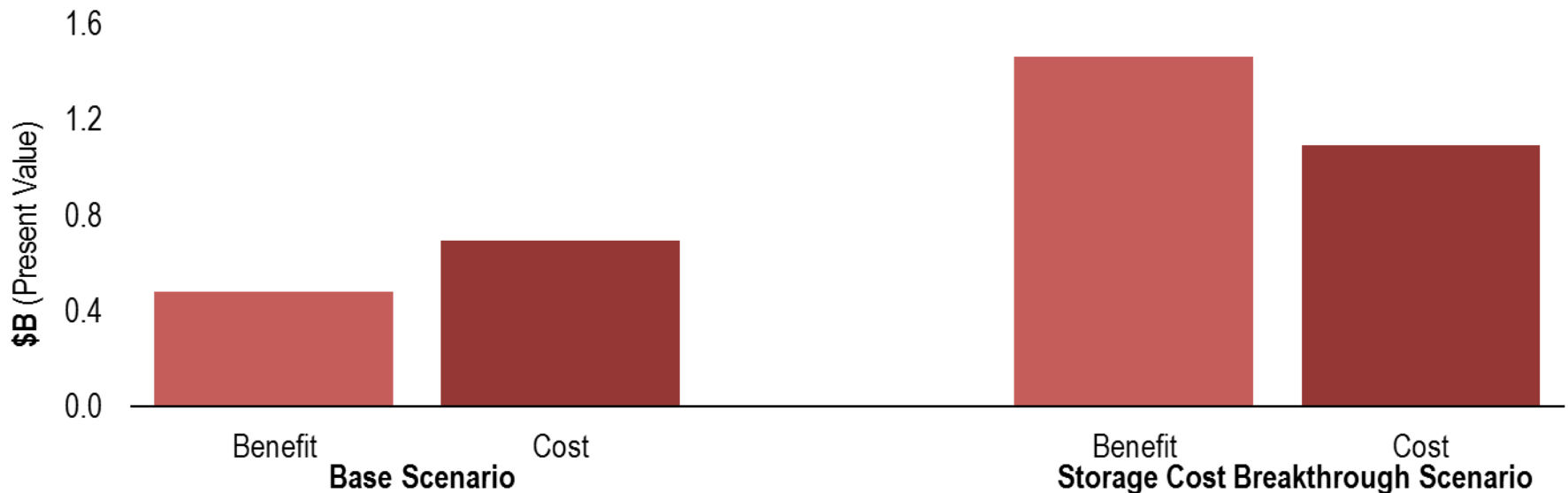
Source: Navigant Analysis



## Storage Costs (on Average) Still Outweigh Benefits

- » However, Storage Cost Breakthrough Scenario shows promise of beneficial storage

**Present Value of Benefits and Costs by Scenario, Grid Storage Integration & Control**

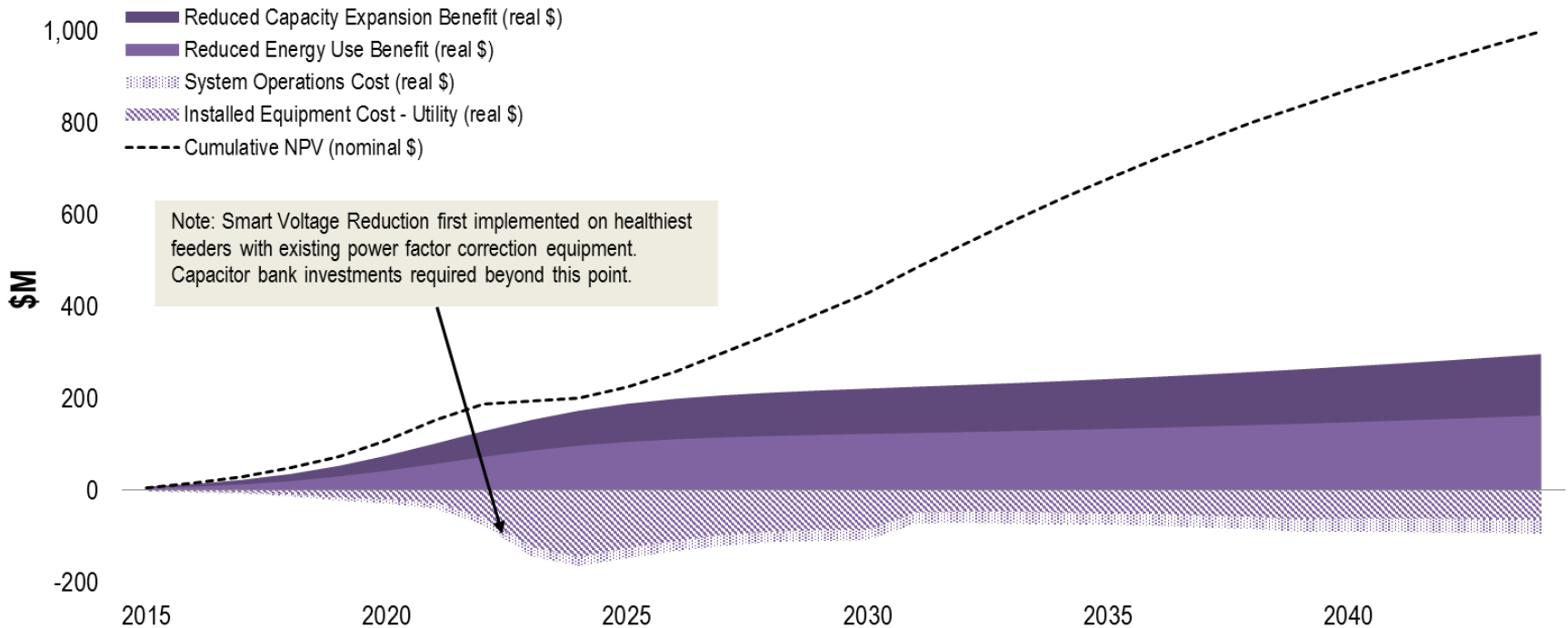


Source: Navigant Analysis

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## Smart Voltage Reduction Can Create Immediate Benefits in the Region

### Time Series of Benefits and Costs of Smart Voltage Reduction

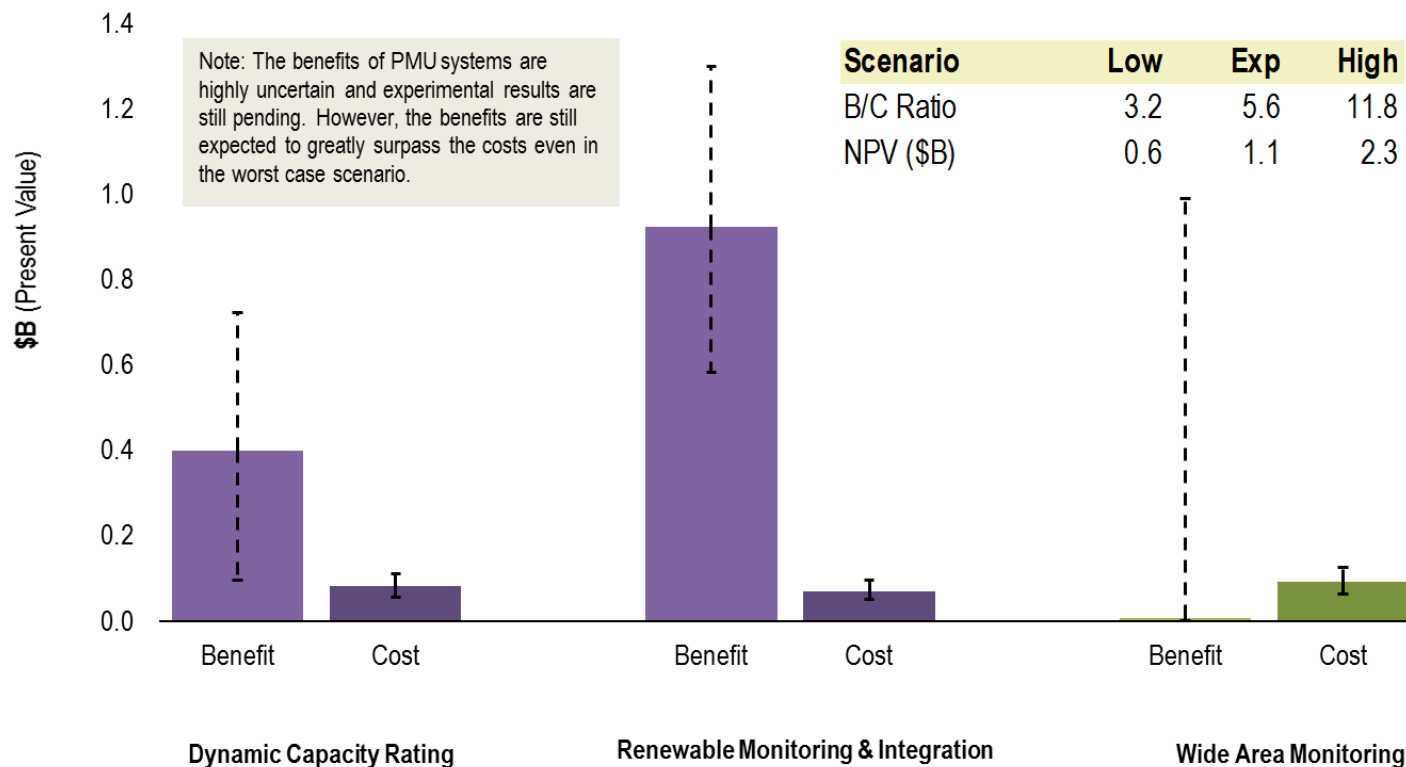


Source: Navigant Analysis

# PMU Applications Provide Reliability Insurance and Other Benefits

## PMU Applications Have Large, Uncertain Benefits, but Very Low Relative Costs

Present Value of Benefits and Costs of PMU Applications

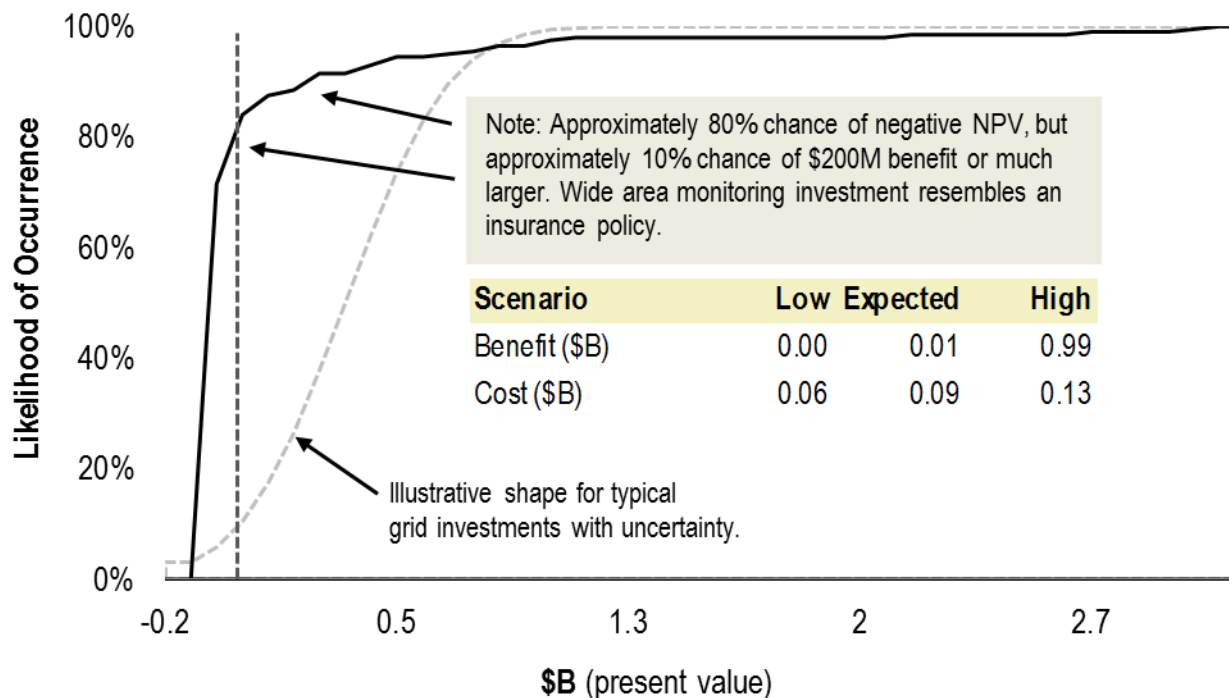


Source: Navigant Analysis

## Wide Area Monitoring Provides Insurance Against Costly Regional Outages

### Net Present Value of Wide Area Monitoring

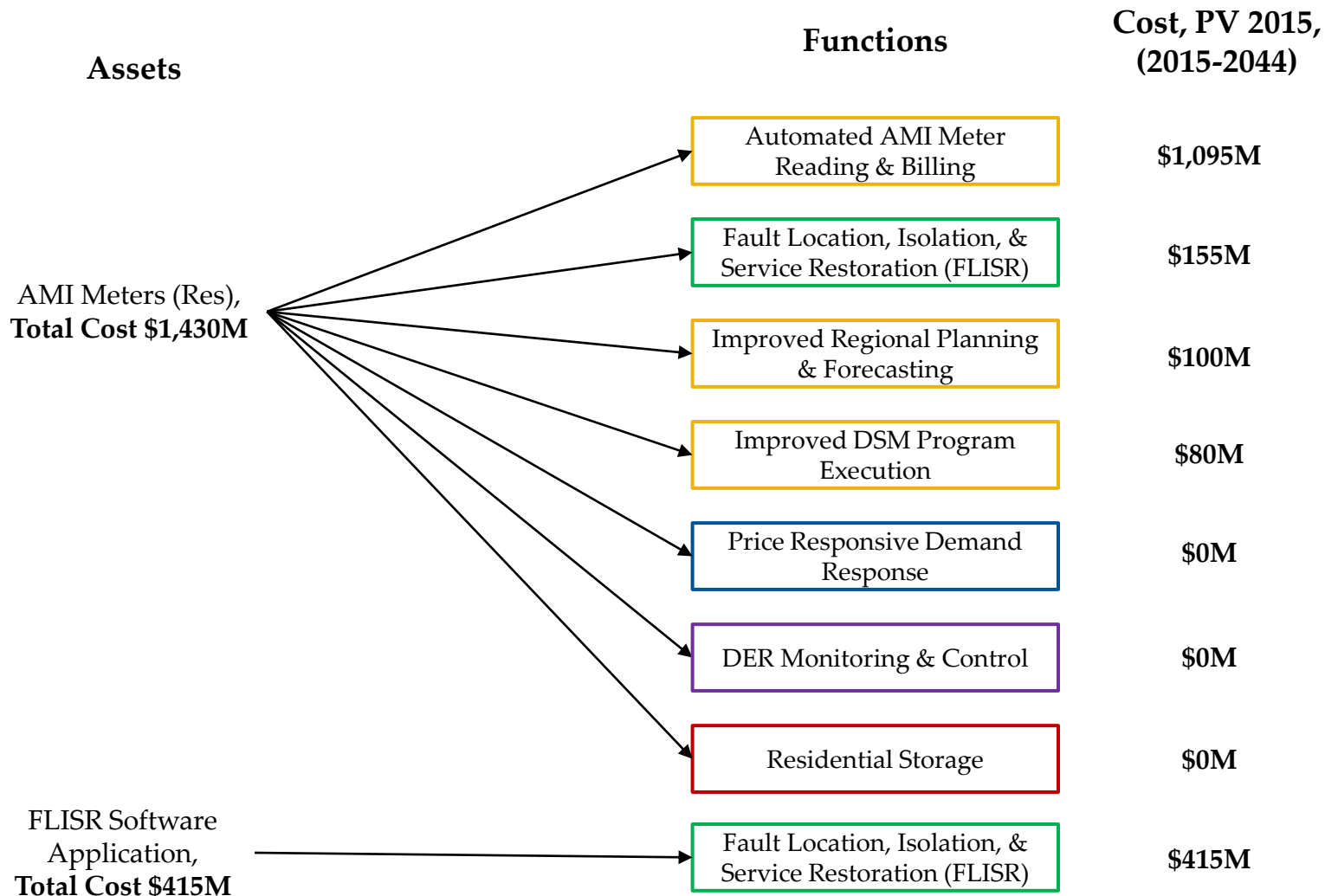
(Cumulative Probability Results)



Source: Navigant Analysis

# Synergies Between Assets and Functions

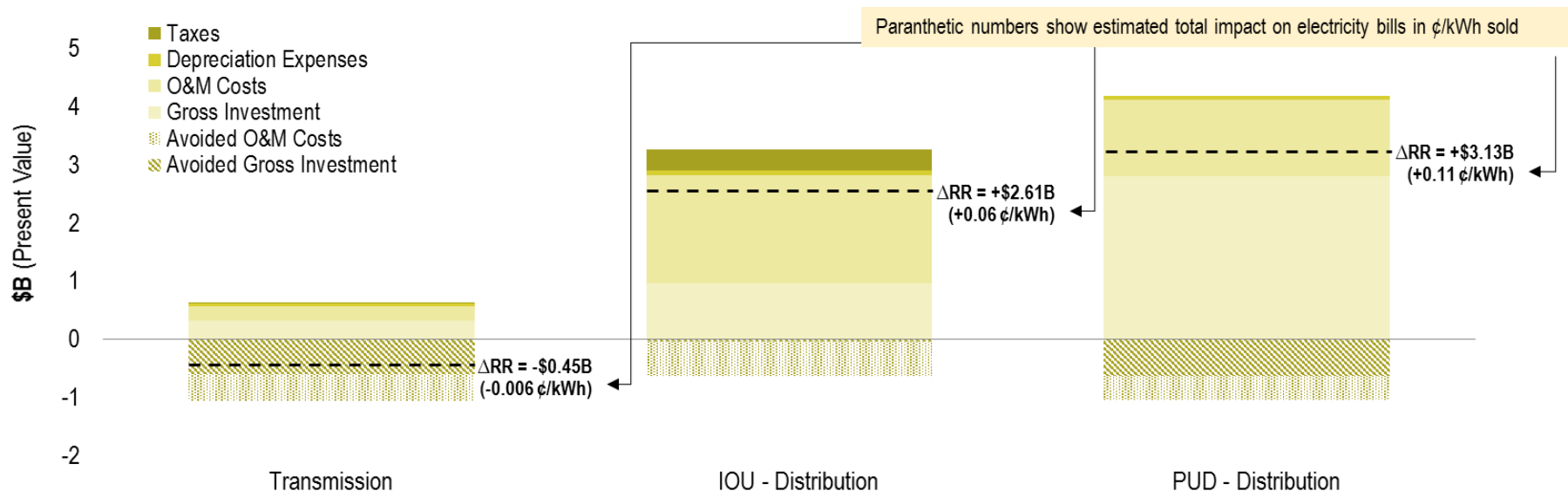
## Some asset costs are shared across multiple functions



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## Regionwide Change in Revenue Requirements from Smart Grid Are Small

Present Value of Incremental Revenue Requirements, by Utility Category (2015-2044)



Source: Navigant Analysis



# Planning for Smart Grid Investments

## Investment Framework Approach—Provides Decision Makers with a Way to Think about RBC Results

### Approach

Expected NPV

Negative

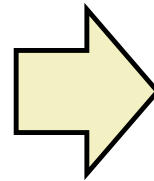
Positive

Range of Uncertainty

Low

High

Identify Niche Opportunities	Pilot & Deploy
Wait and Monitor	Test & Familiarize



### Application

Expected NPV

Negative

Positive

Range of Uncertainty

Low

High

<ul style="list-style-type: none"> <li>• Smart Lighting DR</li> <li>• Smart Space Cooling DR</li> <li>• Equip. Condition Notify EE</li> <li>• Equip. Upgrade EE</li> <li>• Electric Vehicle Storage</li> </ul>	<ul style="list-style-type: none"> <li>• T&amp;D Opt. (IC)</li> <li>• Grid Reliability (IC)</li> <li>• Smart Voltage Reduction</li> <li>• Advanced Voltage Cntrl</li> <li>• Dynamic Capacity Rating</li> <li>• Smart Industrial DR</li> <li>• Smart Space Heating DR</li> </ul>
<ul style="list-style-type: none"> <li>• Electric Storage (IC)</li> <li>• Appliance &amp; Plug Load DR</li> <li>• Smart Utility Operational</li> </ul>	<ul style="list-style-type: none"> <li>• PMUs Renewable Intgrn.</li> <li>• PMUs Wide Area Mon.</li> <li>• Smart Agricultural DR</li> <li>• Smart Water Heating DR</li> <li>• End Use Conservation EE</li> </ul>

Source: Navigant Analysis

## The Smart Grid Regional Business Case: Looking Forward

- » RBC is *regional*, not utility-specific
  - Utilities should conduct analysis specific to their customer demographics and preferences, installed assets, and management preferences
- » Insights can inform policy and regulatory decision makers, utilities, planners, and investors
  - Benefits of T&D investments flow across the value-chain
  - Significant benefits accrue to end-users: reliability, energy savings
  - Overall, revenue requirement impacts are small
- » Next month:
  - Final White Paper
  - White Paper Brief

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