

# Factors Affecting PMU Installation Costs

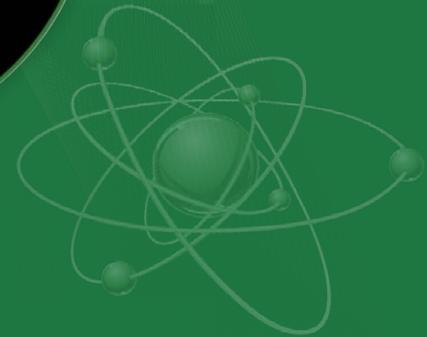
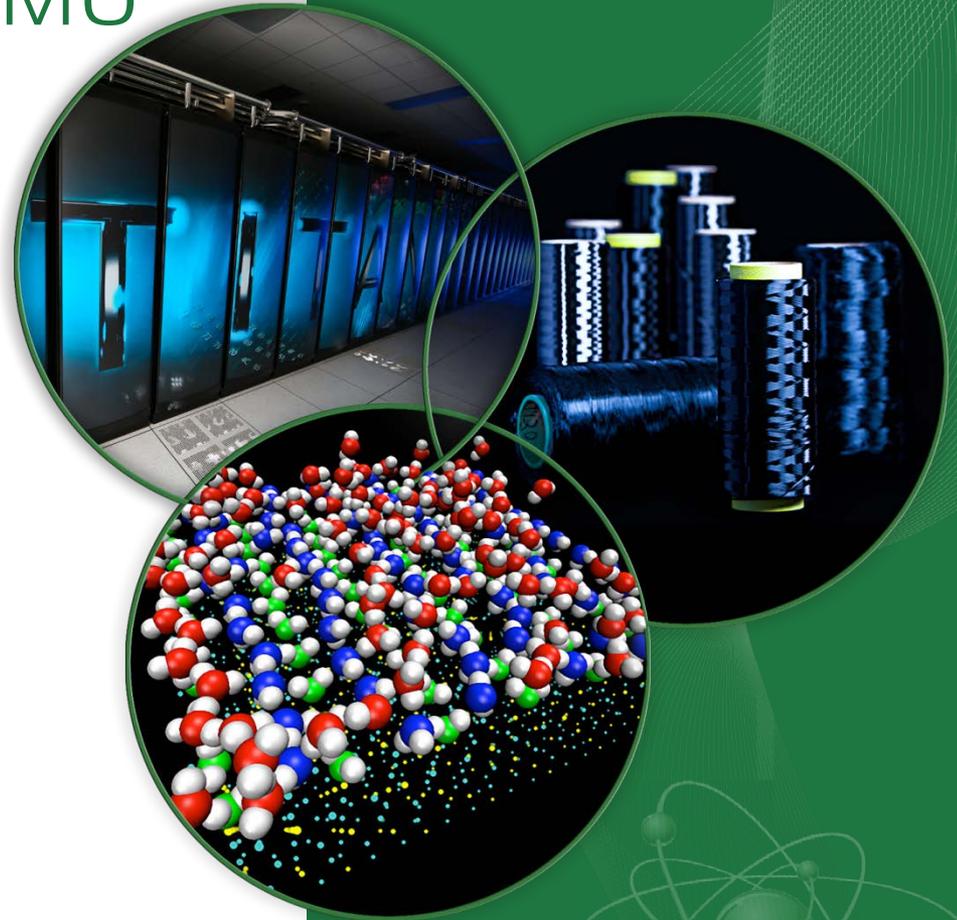
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Houston, TX

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ORNL is managed by UT-Battelle  
for the US Department of Energy



# Overview

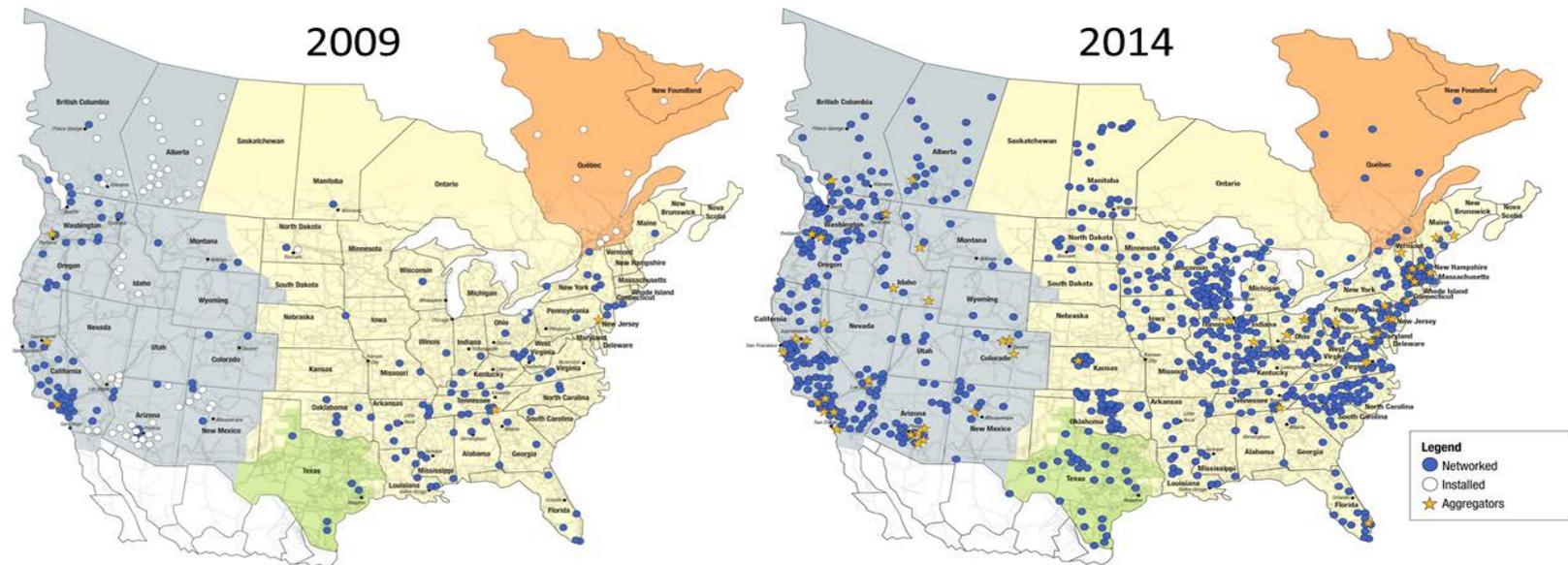
Installing synchrophasor systems involves a number of strategic and tactical decisions.

- Applications and design choices have cost implications for the synchrophasor system.
- There is little empirical data about the detailed cost implications of different system design choices.
- ORNL performed a DOE-sponsored study to explore high level requirements and cost impacts.
- Participants -- Nine transmission owners and reliability coordinators that were part of the SGIG/SGDP projects

This study focused on PMU acquisition and installation costs.

# American Recovery & Reinvestment Act

- Smart Grid Investment Grants (SGIG) and Smart Grid Demonstration Projects (SGDP)
- Public funds matched by private investment
- Managed by the U.S. Department of Energy – Office of Electricity Delivery and Energy Reliability (DOE-OE)



Source: North American Synchrophasor Initiative (NASPI)

Approximately 1,500 PMUs Installed from 2009 to 2014

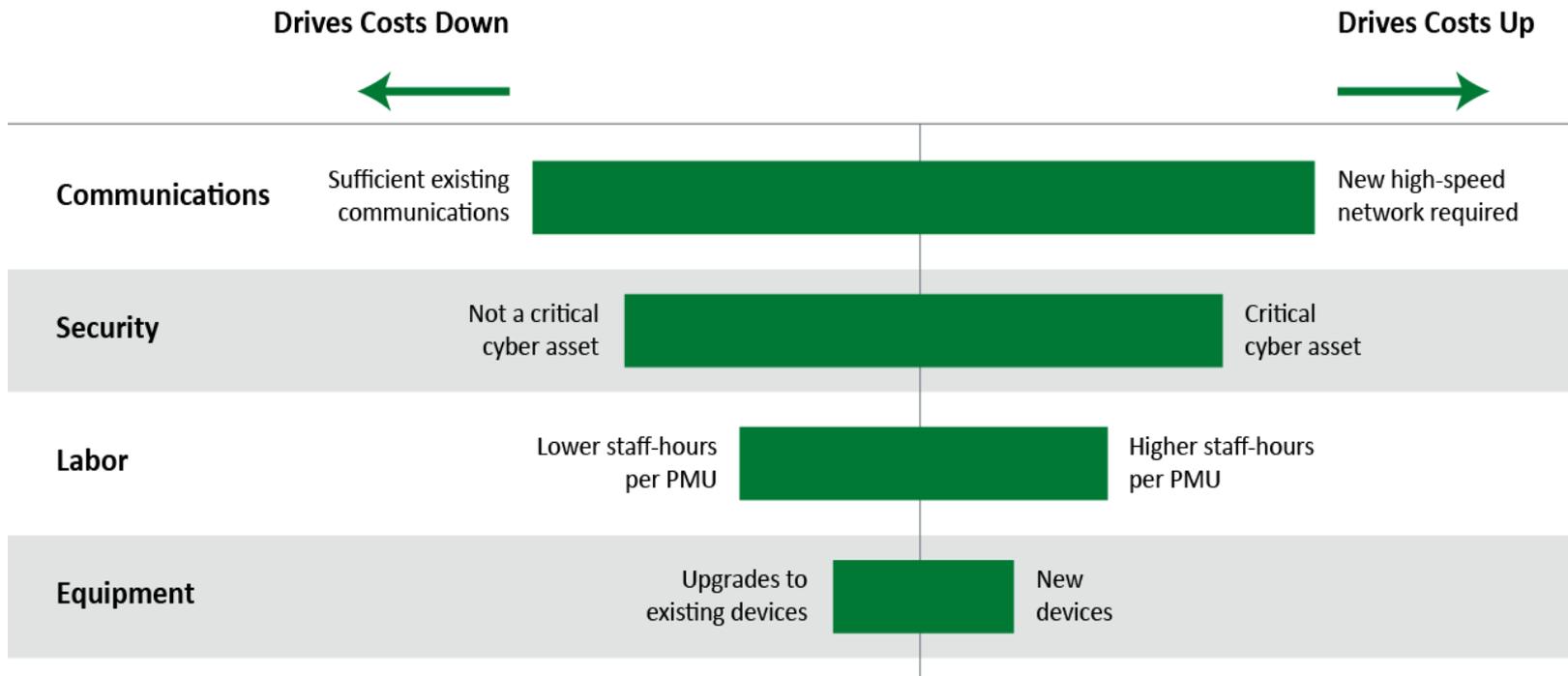
# Participants

- 8 TOs and 1 ISO
- Consisted of prime and indirect recipients
- Participation through interviews and document review

NERC Region	Entity
WECC	BPA Idaho Power PG&E
SERC	Duke Entergy
Midwest Reliability, Reliability First	MISO ATC Manitoba Hydro
Texas Reliability Entity	Oncor

Historically, many of these participants have shared their experiences in the NASPI community

# Key Cost Drivers

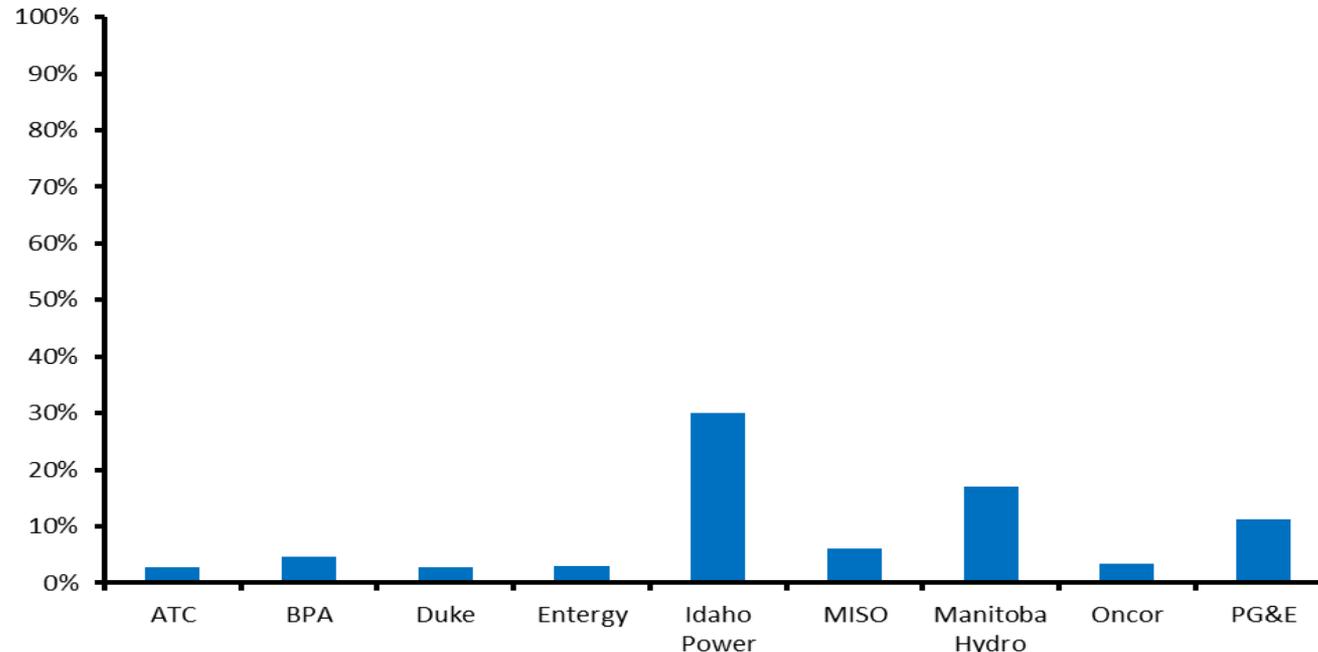


*Ranges are illustrative.*

The availability of communications was the single largest driver of the total costs.

# Average PMU Device Cost

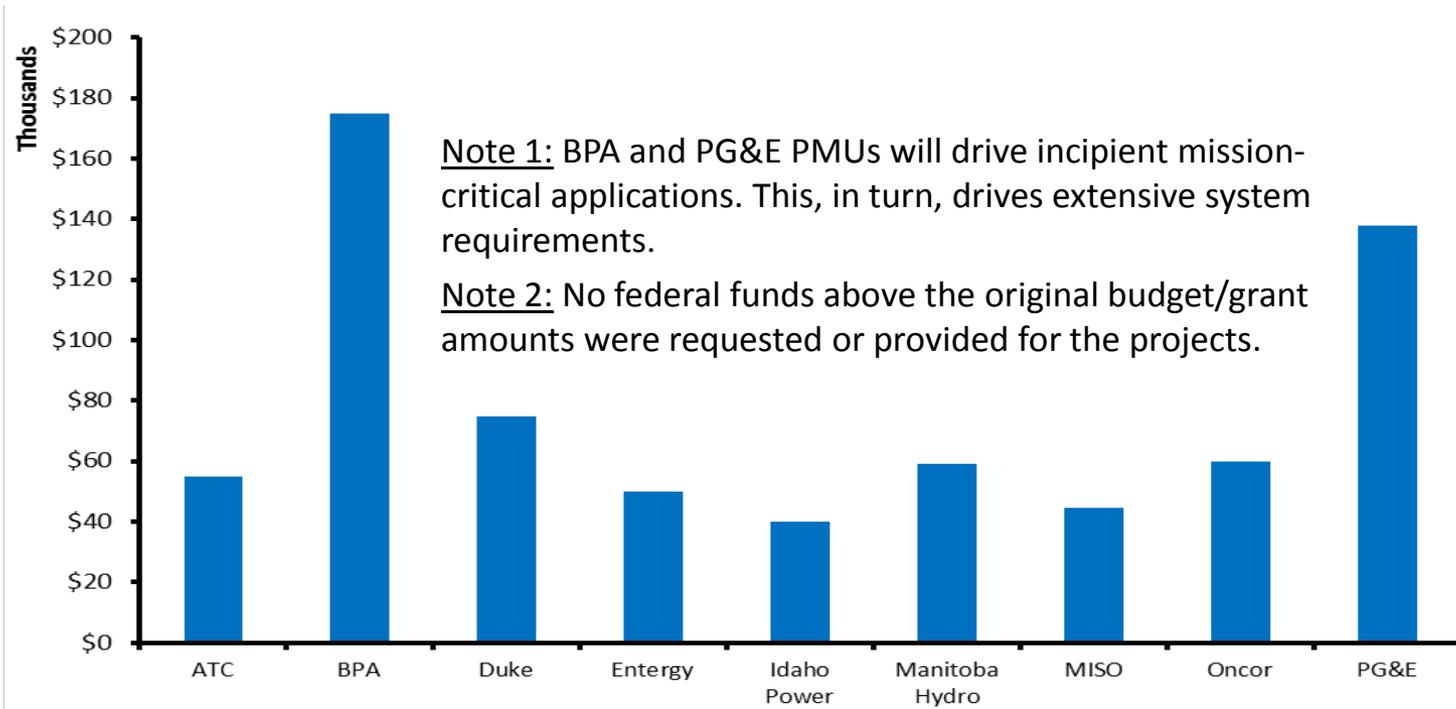
- The study compared the average PMU device cost to the average overall installed cost for each participant.



- The cost of PMU devices was typically less than 10% of the overall cost.
- PMU device cost higher in cases where overall costs were comparatively low.

# Average Overall Cost per PMU

The averages include cost of communications, security, labor and other factors that each participant allocated to their PMUs.



The overall costs are primarily driven by the intended use (both present and future) of the synchrophasor system.

# Summary

## Four key cost drivers emerged

- Communications and security are the factors that drive the largest cost impacts.
- Labor is highest in some cases. Specialized vs. decentralized work crews and size of project's geographic footprint.
- Cost of PMU devices are an extremely small driver of the overall project cost.
  - Some of the study participants activated PMU functionality within existing devices rather than purchase new PMUs.

Each company's plan for synchrophasor use drove their requirements, and thus the costs.

# Find the report on: [www.smartgrid.gov](http://www.smartgrid.gov)

[https://www.smartgrid.gov/sites/default/files/doc/files/PMU\\_cost\\_study\\_Final\\_09232014.pdf](https://www.smartgrid.gov/sites/default/files/doc/files/PMU_cost_study_Final_09232014.pdf)

The screenshot shows the SMARTGRID.GOV website. At the top, there are navigation tabs: "What is the Smart Grid?", "Recovery Act Smart Grid Programs", "Federal Smart Grid Initiatives", and "Smart Grid Resource Center". Below these is a search bar and a "Home | About | News | Glossary | Contact" link. The main header area features a large green banner for "Recovery Act Smart Grid Investments" with a sub-menu containing "Access key program results" (circled in red), "Search for project descriptions and information", "Learn about the program", "View technical deployment studies", "Learn about the Consumer Behavior Studies", and "Download key reports". To the left of the banner are three smaller boxes: "What is the Smart Grid?", "Other Federal Smart Grid Initiatives", and "Smart Grid Resource Center". Below the banner is a "RECENT PUBLICATIONS" section with a list of reports from September 2014, including "Customer Participation in the Smart Grid - Lessons Learned" and "Experience from the Consumer Behavior Studies on Engaging Customers". To the right of this is a "NEWS AND UPDATES" section with a "Sign up for SmartGrid.gov email updates >>" link. The main content area is titled "Program Impacts" and includes a sub-menu with "OVERVIEW OF PROGRAMS", "PROJECT INFORMATION", "DEPLOYMENT STATUS", "PROGRAM IMPACTS", "CONSUMER BEHAVIOR", and "PROGRAM PUBLICATIONS". The "PROGRAM IMPACTS" section is highlighted in green and contains the text: "The U.S. Department of Energy (DOE) is analyzing the impacts of the Recovery Act smart grid projects on the electric system and examining costs, benefits, lessons learned, and best practices. This effort is an opportunity to inform decision makers about the relative merits of alternative smart grid technologies, tools, and techniques and provide a stronger empirical basis for investments and business cases." Below this are three columns of content: "Smart Grid Investment Grants" with an "Impact Analysis" section, "Smart Grid Demonstration Projects" with "Technology Performance" and "Regional Demonstration Projects" sections, and "Energy Storage Demonstration Projects". At the bottom, there is an "ANALYTICAL APPROACH" section with the text: "DOE is implementing an approach to provide an objective assessment of the benefits of the Smart Grid." A red arrow points from the "Access key program results" link to the "click 'Access key program results'" text. Another red arrow points from the "click 'Synchrophasor Applications in Transmission Systems'" text to the "Synchrophasor Applications in Transmission Systems" link in the "ANALYTICAL APPROACH" section.

click "Access key program results"

click "Synchrophasor Applications in Transmission Systems"