

The Convergence of the Smart Grid with Photovoltaics: Identifying Value and Opportunities



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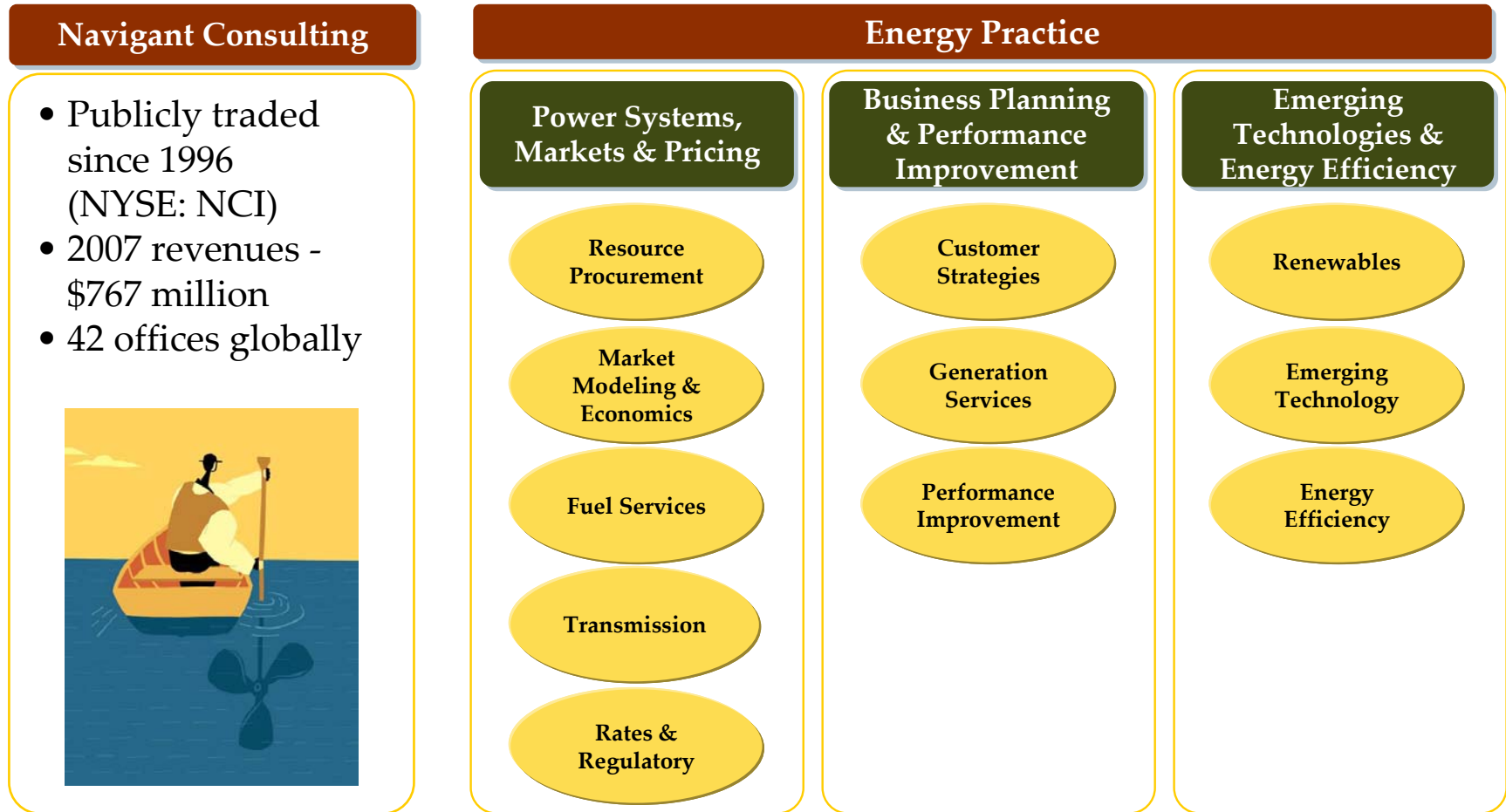
Smart Grids

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Navigant Consulting, Inc. (NCI) is a specialized consulting firm known globally for its emerging energy technology and strategy expertise.



Our Energy Practice is a leader in covering Clean Energy issues.

Situation

While the PV market has entered a time of robust growth, electric utilities and others have begun to implement the Smart Grid.

PV Drivers

- PV cost competitiveness
- Investment in technologies, projects and new business models
- Demand for green energy

Smart Grid Drivers

- Energy reliability and security
- Integration of renewable energy
- Customer experience and end-users as energy partners

Navigant Consulting is completing a large multi-client study to examine the value and opportunities created by integrating PV with Smart Grid.

Opportunity

The *PV-Smart Grid* may present an opportunity to address key issues faced by PV and Smart Grid alone.

Does *PV-Smart Grid* :

PV Drivers

- Enable higher penetration of PV?
- Help PV provide value for the grid?
- Create new business opportunities?

Smart Grid Drivers

Smart Grid Enables More PV on Distribution Feeders

The Smart Grid enables higher penetrations of PV by addressing key technical challenges.

Can the PV-Smart Grid enable higher penetrations of PV?

- Barriers to high penetration of PV include:
 - Technical T&D challenges
 - Communications challenges
 - Regulatory and business model challenges
- The Smart Grid addresses key technical T&D challenges
- By addressing the technical issues will allow utilities to accept more PV on distribution feeders without compromising operating performance and service quality

Yes. Smart Grid could support more PV on distribution feeders.

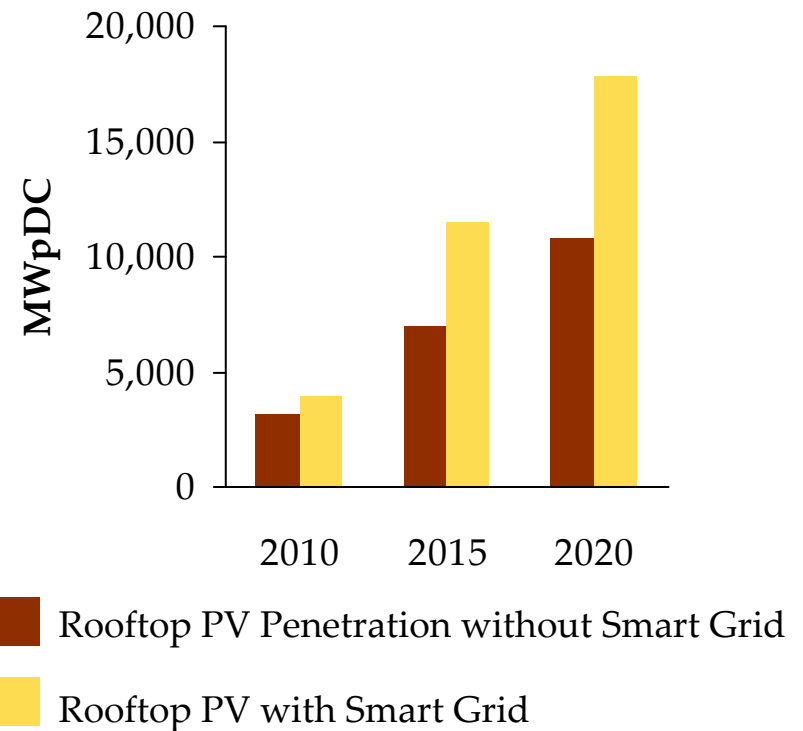
Increased Distributed PV Penetration

NCI estimates that rooftop PV penetration could be significantly higher by 2020 as a result of addressing T&D barriers with Smart Grid.

The Smart Grid Enables Higher Penetration of PV

- The Smart Grid coupled with energy storage can address important T&D challenges:
 1. Voltage Regulation
 2. Reverse Power Flow
 3. Power Fluctuations/Frequency Regulation
- Addressing these challenges supports higher net metering caps, better interconnection standards and more prevalent time of use tariffs options

Cumulative Installed Capacity Rooftop PV



High Penetrations of PV Adds New Value

Distributed PV can provide benefits in key areas. Combining this resource with energy storage enhances its value.

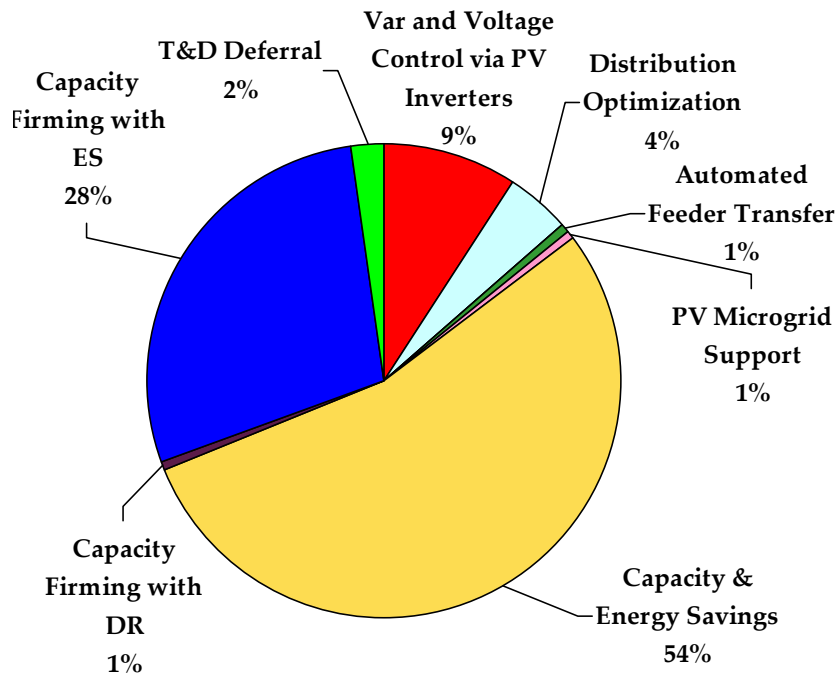
Can the PV-Smart Grid help PV provide value for the grid?

- The greatest value of PV is derived from avoiding central generating capacity and avoided energy costs
- Energy storage is a key for enhancing the value of PV in a Smart Grid context
- When concentrated, PV can provide benefits related to grid optimization
- PV is cost effective assuming continuation of rebates and ITC credits – however, the incremental value of Smart Grid is not enough to overcome the loss of incentives

Yes. PV in high penetrations can provide grid benefits.

Areas of Value Creation

Analysis shows that PV provides value from capacity and energy savings, firmer capacity with energy storage, and grid optimization.



- Capacity and energy savings
- Firmer capacity with energy storage
- Grid optimization

Unlocking Value Could Create New Business Opportunities

By leveraging the Smart Grid and high penetrations of distributed PV, new opportunities to unlock value can be created.

Can the PV-Smart Grid create new business opportunities?

- The analysis reveals three main areas for new value:
 - Deferred/avoided energy and capacity from traditional generation
 - Smart capacity firming by combining PV with energy storage
 - Grid optimization through coordinated control of PV inverters
- Tapping this value will require enhancements to technology, policy and business models

Yes. PV-Smart Grid could create new business opportunities.

Enhancements to Achieve Benefits

Achieving the benefits highlighted in the study requires enhancement of technology, policy and business models.

Technology

- Technical/business requirements for coordination of AMI and PV
- Functional requirements for leveraging PV as a grid resource

Policy

- Eligibility of integrated PV/energy storage systems for state/federal rebates and Investment Tax Credits
- Modification of technical standards (e.g., IEEE 1547) to allow PV inverters to provide grid support

Business Models

- Tariffs and pricing mechanisms that monetize the benefits provided by distributed PV
- Service offerings to facilitate participation of PV as a grid resource

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