

Soft Cost Benchmarking and Opportunities for Cost Reduction

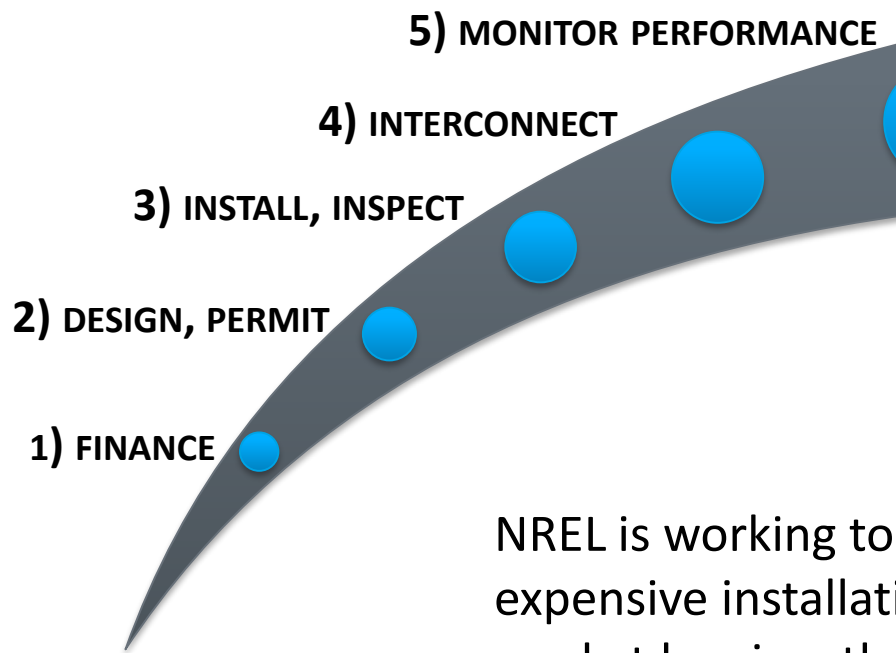
Balance of Systems (BOS)

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NREL is working to enable faster, easier and less expensive installations by addressing soft costs and market barriers through data collection, analysis, and assistance to decision-makers who affect solar markets.

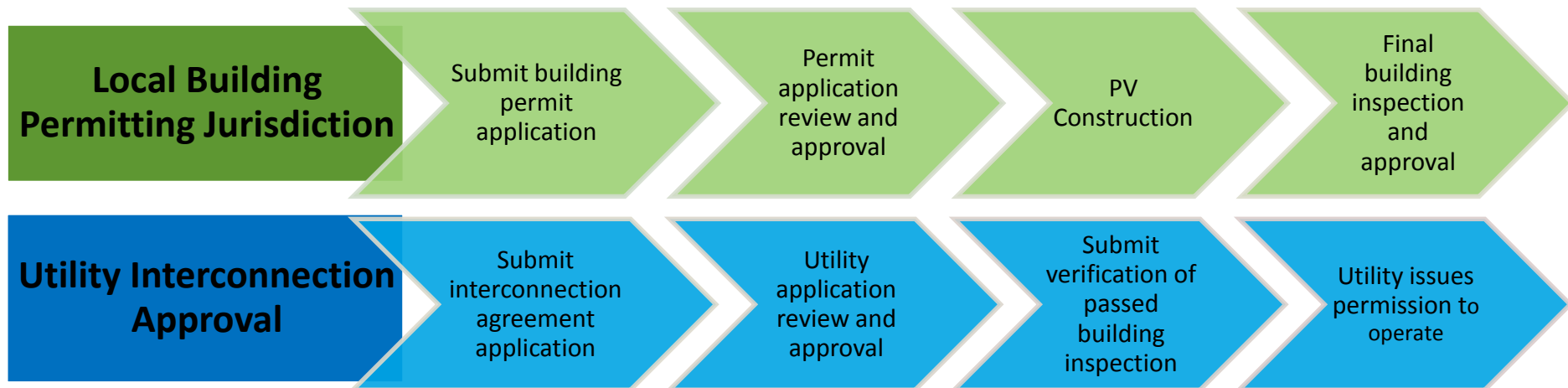
There is more to PV than Hardware
Need for transparent, consistent, efficient processes.



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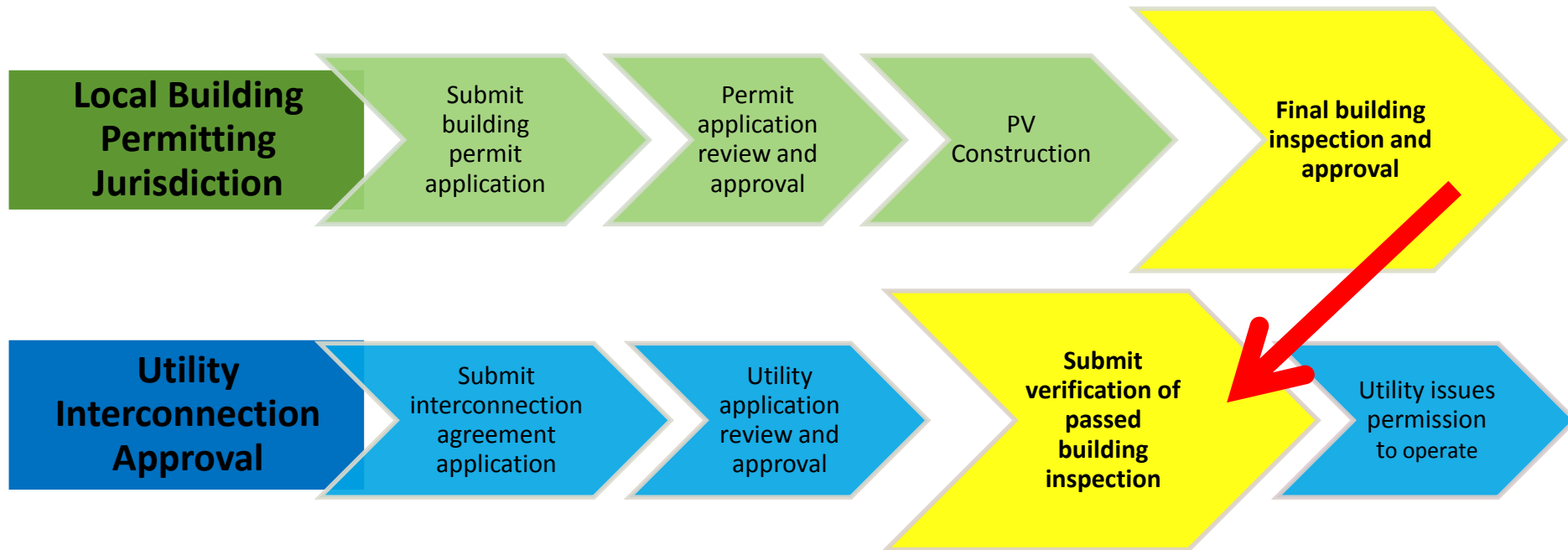
Distributed PV System Approval

- Distributed PV typically subject to parallel approval processes:
 - Building/electrical permit AHJ
 - Utility interconnection

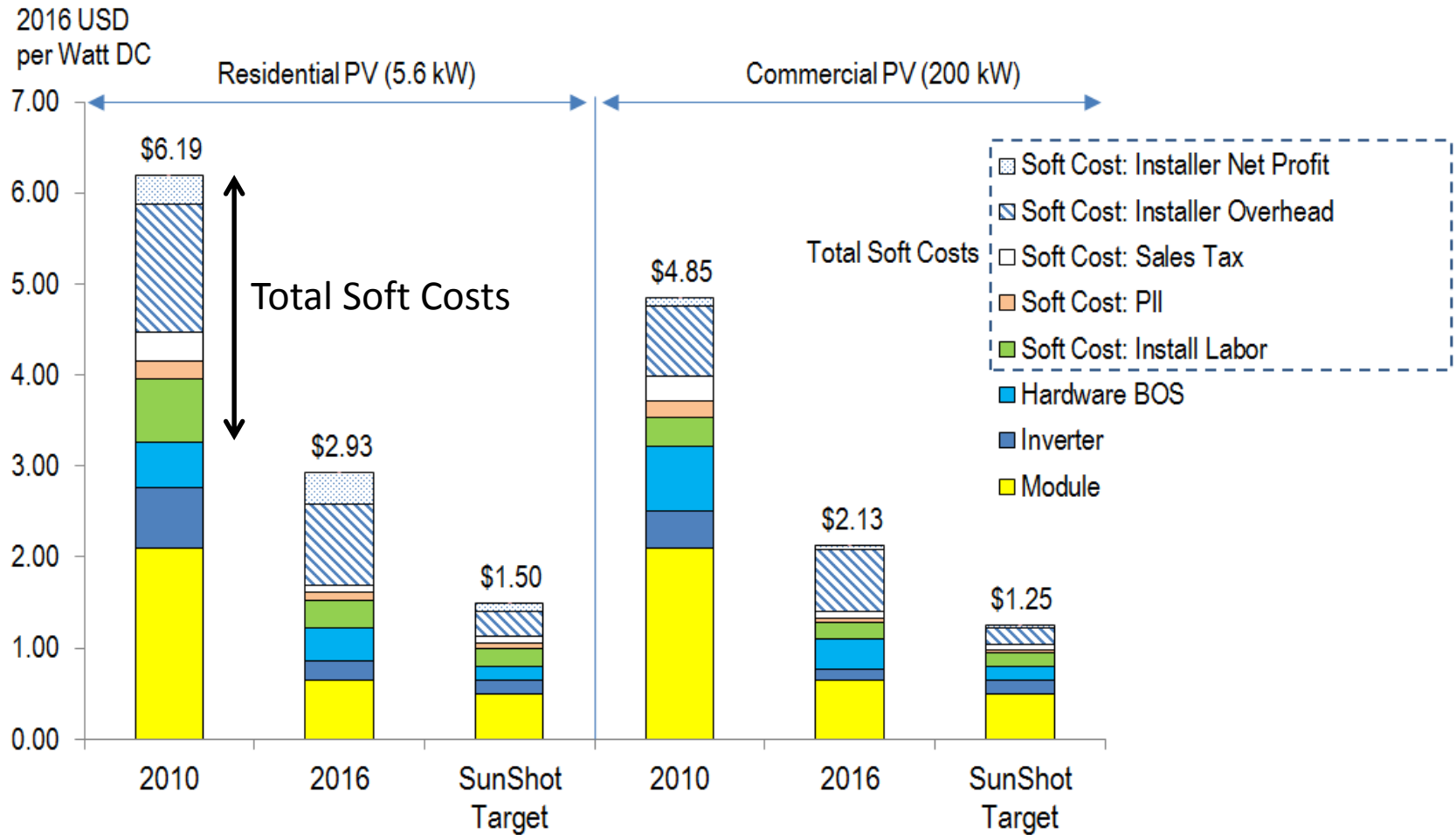


Distributed PV System Approval

- Coordination between the utility and building permitting jurisdiction is often required
 - verification of passed building inspection needed prior to the utility issuing permission to operate



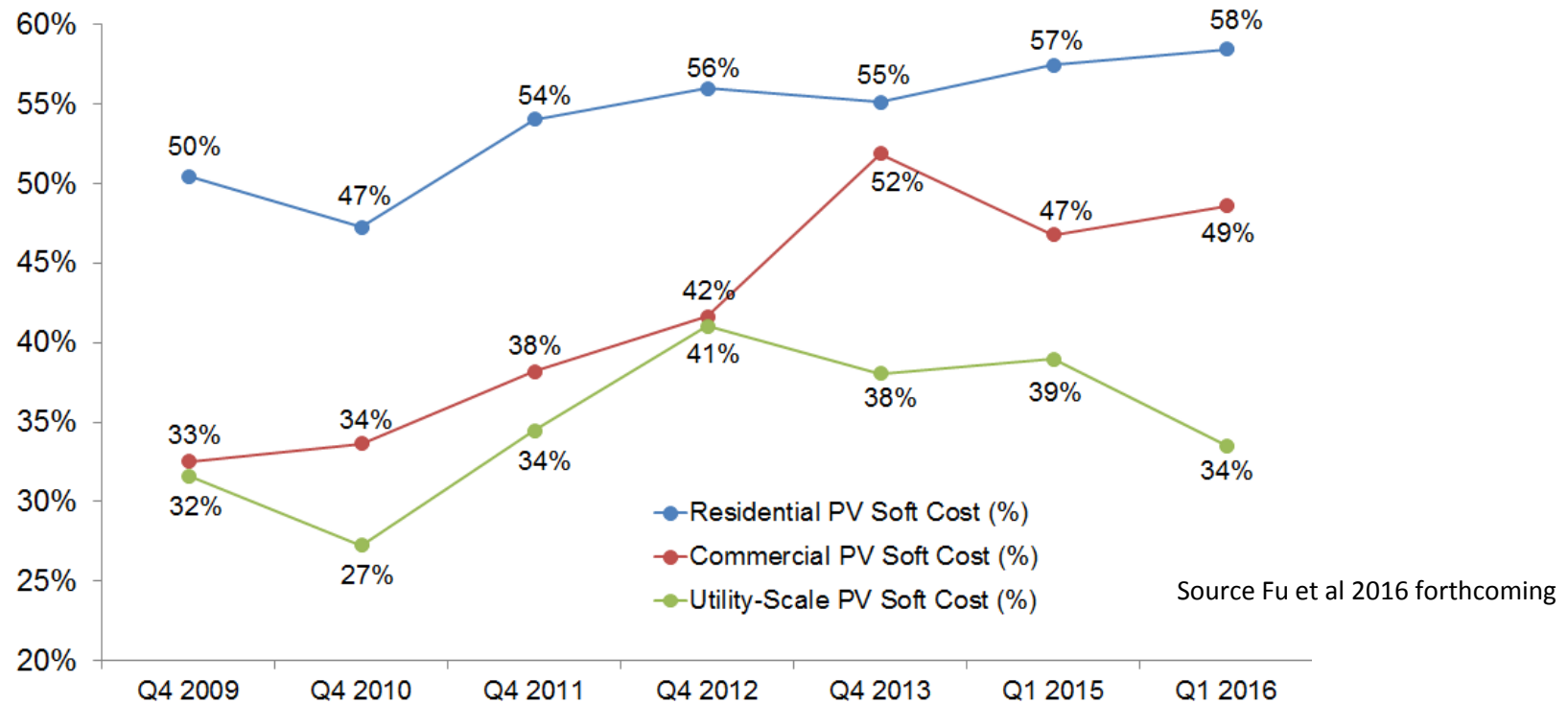
Balance of Systems (BOS)



Residential	2010 (\$/W)	2016 (\$/W)	2020 (\$/W)
Total Price	6.19	2.93	1.50
Soft Costs	2.93	1.71	0.70

Commercial	2010 (\$/W)	2016 (\$/W)	2020 (\$/W)
Total Price	4.85	2.13	1.25
Soft Costs	1.63	1.03	0.45

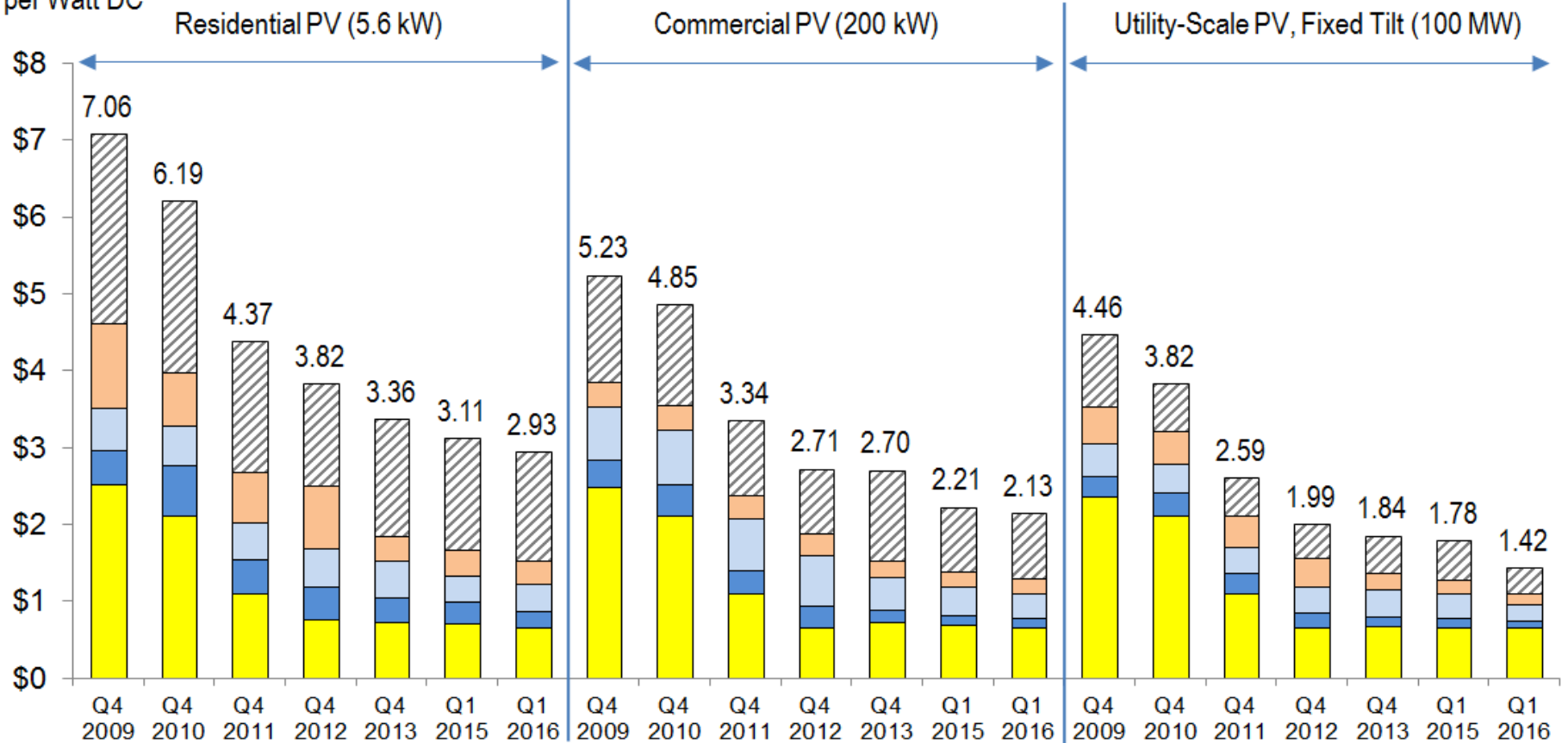
Soft Costs as a Percentage of PV System Price 2009-2016



- Contribution of soft costs to total system price has remained relatively constant for the utility scale system
 - ~34% of utility system prices
- Contribution of soft costs to total system price increased for the residential and commercial sector
 - From 50% to 58% for residential sector over the same time period
 - From 33% to 49% for commercial sector over the same time period

PV System Installed Costs 2009-2016

2016 USD
per Watt DC



- ▨ Soft Costs - Others (PII, Land Acquisition, Sales Tax, Overhead, and Net Profit)
- ▤ Soft Costs - Install Labor
- ▥ Hardware BOS - Structural and Electrical Components
- ▦ Inverter
- ▧ Module

State-level Drivers for Solar Deployment

Policy and Legislative

- Renewable Portfolio Standards (with Solar set asides)
- Third Party Ownership
- Community Solar
- Permitting and Interconnection Best Practices
 - e.g. CA Solar Permitting Efficiency Act

Consumer Education

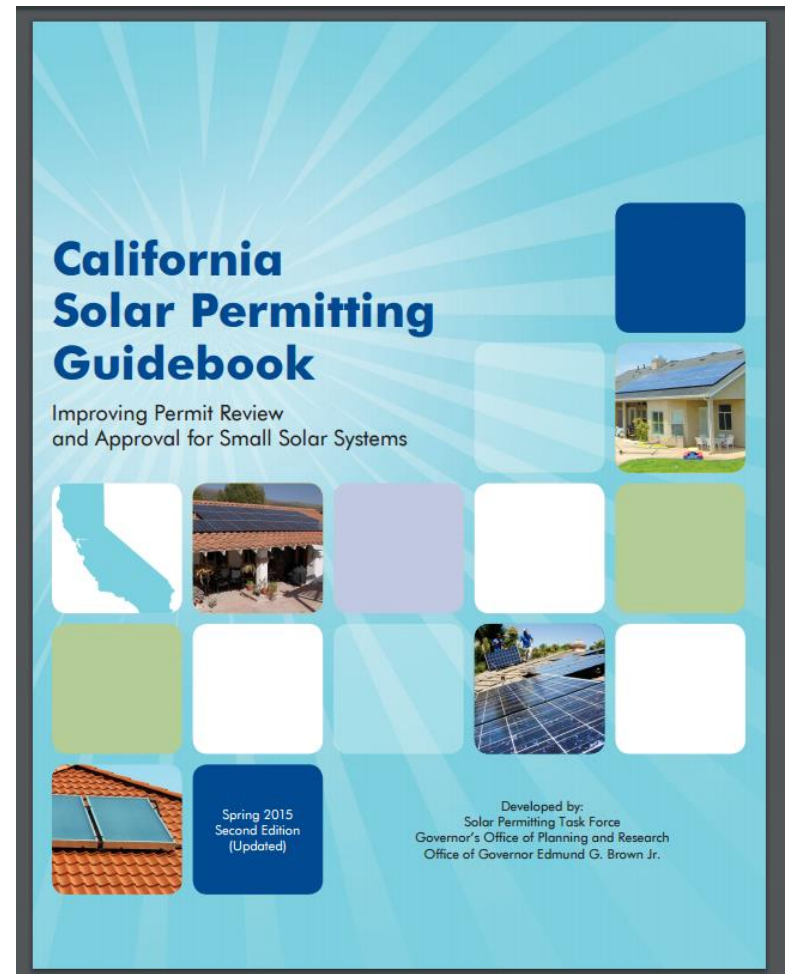
- Consumer Protection Considerations
- Online Tools and Apps
- Best Practices/Guidebooks

Financial Incentives

- Personal Tax Credits
- Rebate Programs
- Performance Based Incentives


State Legislation to Improve Solar Permitting

- CA Solar Permitting Efficiency Act required the state's more than 540 cities and counties to adopt an ordinance that creates a streamlined, expedited permitting process for residential rooftop solar energy systems by September 30, 2015
- Cities and counties must conform their expedited, streamlined permitting process to recommendations contained in the current version of the California Solar Permitting Guidebook. e.g.
 - Adoption of a checklist of all requirements for a system to be eligible for expedited review.
 - The use of electronic signatures on relevant permitting documents unless a jurisdiction is unable to process them.
 - A single inspection, subject to certain exceptions, that must be performed in a timely manner.



NREL Case Study: Pacific Gas and Electric Process Innovation

- PG&E has more distributed PV than any other utility in the U.S.
- Experienced an increase from 584 annual interconnections in 2001 to ~70,000 by the end of 2015.
- After eliminating unnecessary requirements, PG&E focused on measures to streamline the process and then to automate it.
- Highlights of process improvements include
 - online application completion and submission
 - capability to auto-populate key application inputs
 - integration of several back-end data streams that were previously isolated from one another
 - automated the initial engineering review for potential system-load impacts.



**Decreasing Soft Costs for Solar Photovoltaics by Improving the Interconnection Process:
A Case Study of Pacific Gas and Electric**

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NREL is a national laboratory of the U.S. Department of Energy
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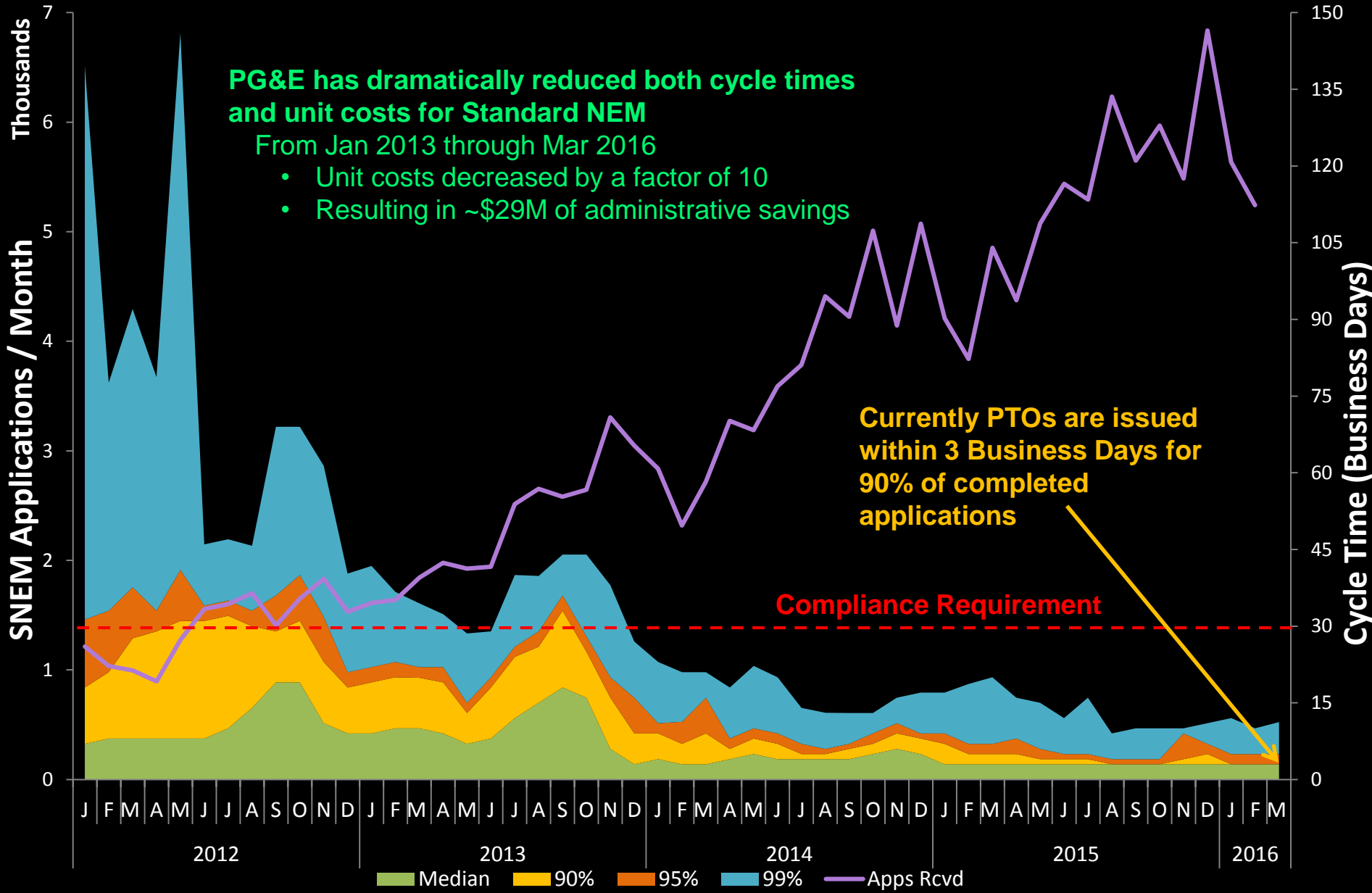
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Rooftop Solar Cycle Times



Balance of Systems (BOS)

Thank you!