# Soft Cost Impact Forum Summary Document: Installation Labor

2317 Snowmass Creek Road | Snowmass, CO 81654

Rocky Mountain Institute®

Eric Wanless, ewanless@rmi.org
Jesse Morris, jmorris@rmi.org
Koben Calhoun, kcalhoun@rmi.org

On October 21st 2013, Rocky Mountain Institute (RMI) and the National Renewable Energy Laboratory (NREL) convened a forum with a broad group of industry stakeholders to address three different soft cost areas for residential and small commercial rooftop solar photovoltaic (PV) systems: installation labor costs, PV operational costs, and distributed generation (DG) interconnection and integration costs. This brief report summarizes the discussion and outcomes of the installation labor breakout group.

Discussion in the installation labor group focused on different ways for industry to reduce installation labor-specific costs for installers and developers. After a series of brainstorming sessions and a down selection process, four potential solutions / impact groups were built-out during the workshop:

1. **Integrator Process Standards Body for Residential and Commercial PV Systems / Solar Master Reference Point**
2. **WikiSolar**
3. **National Solar Database**
4. **Solar-Ready Standards Campaign**

RMI, in partnership with industry, will be facilitating the launch of one or several of these concepts in the next several months pending industry feedback.

## Workshop Overview

After a brief presentation from RMI on SIMPLE BoS, a current RMI-Georgia Tech Research Institute project in the installation labor space, forum participants were presented with four initial concepts to consider as framework solutions or working groups that could enable installation labor cost reductions across the residential and commercial PV industry. Participants then broke into smaller groups and were asked to both explore specific challenges in the installation labor space and to develop additional solutions or working group concepts for consideration. Prior to building out these concepts in detail, discussion was broad and covered many different topics, summarized at the end of this document in Appendix A.

## Potential Cost Reduction Solutions and Concepts

After an open-ended brainstorm and discussion, forum participants were asked to prioritize specific solutions and potential working groups with the potential to drive down installation labor costs across industry. The down selected concepts are presented below.

**Concept 1: Integrator Process Standards Body for Residential and Commercial Systems / Solar Master Reference Point**

*Concept Pitch*
Additional, and oftentimes superfluous, costs are incurred in each successive step of the installation process from customer engagement to successful system operation. Cradle to grave industry process and hardware standards that encompass the entire installation process could help guide the smooth transition between each step, reducing friction, cost, and increasing the speed of PV adoption.

*Analogous Examples*
MasterFormat, RS Means, Automotive Flat Rate Structure, NREL SAPC

*Concept Outcomes*
A standards body dedicated to rooftop solar PV installations could result in several different outcomes, helping to simultaneously resolve multiple issues in the installation labor space:

- A standards body would initially establish a solar domain specific language, enabling more accurate bids based on clearly defined and benchmarked variables including hardware selection, module type, jurisdictional requirements, and regional architectural characteristics.
- Such a language would dramatically increase efficiency by eliminating a majority of re-work, simplifying some construction tasks, lowering training requirements for both sales and construction crews, reducing

customer complaints, lowering financing costs, and simplifying product offerings for customers.

- Using this language, the standards body could provide third party verification of installation labor efficiency claims, both informing EPC firms and driving product consolidation within and amongst hardware manufacturers.
- The standards body could also conduct detailed task analyses of select companies to anonymously inform installation training curriculums, the goal being to eliminate misaligned incentives within installation companies—especially between sales teams (who are typically incentivized to maximize capacity per sale) and construction crews (who incur increased installation costs from oversized, complex, multi-array systems).

For this concept to succeed, forum participants suggested that active participation on the standards body by the three largest residential and commercial integrators in the U.S. would be required since their involvement would help to signal widespread acceptance of an industry-specific language.

*Concept Funding, Participants, and Initial Steps*
A successful standards body would need involvement from large U.S. integrators, installation training organizations, EPC firms, existing industry associations, banks, and insurance companies involved in the solar space to succeed. The body would need to be primarily funded by direct industry investment, perhaps facilitated initially by an unbiased organization similar to RMI or NREL.

Near-term deliverables include recruitment of key initial participants, identification of parallel developments, and creation of a working group. Initial meetings would need to convene by Q1 of calendar year 2014, the goal being an alpha release of standards by Q4 of 2014.

**Concept 2: WikiSolar**

*Concept Pitch:*
Installers and integrators can help each other lower soft costs (and offer more aggressive pricing) when they're able to share best practices, product experiences, and provide consolidated feedback to PV module and hardware manufacturers. A crowdsourced platform that amalgamates user-generated content from installers and integrators would enable an unprecedented level of data sharing, best practice identification, business to business (B2B) connectivity, and create a powerful single voice for the downstream solar industry to provide detailed feedback upstream to panel and balance of system manufacturers.

*Analogous Examples*
Yelp, Angie's List, all user-certified Wiki-based platforms

*Concept Outcomes*

A largely B2B wiki-based platform could lead to several outcomes going well beyond installation labor cost reductions:

- Installers and integrators would learn from peers across the U.S. specifically which products (from modules to fasteners) work better in specific markets or with particular architectures. Such learning could enable near term cost reductions across industry and drive product consolidation within and amongst balance of system hardware manufacturers.
- Assuming active, widespread participation, WikiSolar could act as a powerful, centralized channel for installers and integrators to provide detailed feedback to panel, inverter, and hardware manufacturers. Such feedback would highlight opportunities for small, incremental changes capable of enhancing installation efficiency or system performance. More importantly, crowdsourced feedback from thousands of downstream companies would also highlight major design opportunities for PV manufacturing firms to create new, innovative products that design-out cost and boost efficiency.
- WikiSolar could go well beyond focusing on the hardware, module, inverter, and installation labor pieces of the rooftop solar cost stack. Such a service could enable new levels of B2B connectivity and advertising for solar-specific software providers. Furthermore, WikiSolar could act as a platform for installers and integrators to provide jurisdiction- and utility- specific feedback to help overcome regional permitting, inspection, and interconnection challenges.

Forum participants were unaware of any current platforms similar to WikiSolar. And yet, most installers and integrators clearly understand the value of information sharing and industry feedback, as evidenced by the rich, one-off interactions that commonly take place at industry convening events amongst the various solar industry stakeholder groups. WikiSolar could make these knowledge sharing events much more frequent by providing a platform for them to happen continuously online.

*Concept Funding, Participants, and Initial Steps*

In order for Wikisolar to succeed, it's likely that the service would need to receive 50 contributions and/or edits per day one year after its launch. Accordingly, enrollment and active participation in WikiSolar by at least 50% of residential and commercial solar installation and integration firms would be required for success. Furthermore, several of the top panel and balance of system manufacturers may need to conceptually buy in to the service, although their participation would not be mandatory for initial success. Finally, engaging a veteran company or organization in the crowdsourced space (like Wikipedia or Angie's List) would be necessary to ensure successful initial product launch.

Like several of the concepts discussed at the soft cost impact form, its likely that a nonbiased nonprofit or perhaps the Department of Energy could help initially facilitate and fund the tool's creation, but a longer term sustainable business model based on advertising or membership would need to emerge for WikiSolar

to succeed long term. Initial steps would include creation of a steering committee by Q1 2014, followed by an alpha platform launch in Q4 of 2014.

**Concept 3: National Solar Database**

*Concept Pitch*
Transparency means we don't need to make the same mistakes twice. Access to publicly available data can help reduce costs, increase efficiency, and ensure long-term success within the solar industry. A national solar database could provide the access to information necessary to reduce barriers, increase information sharing and transparency, and allow for the more effective utilization of the best products and installation practices.

*Analogous Examples*
California Solar Initiative, NREL OpenPV Project, Microgeneration Certification Scheme

*Concept Outcomes*
A National Solar Database in publicly accessible form integrated with other databases and information sources would produce a number of beneficial outcomes, again with the potential to reduce costs in many areas, not just installation labor:

- Such a database would have detailed installation data on projects including the date the system was energized, module type, company, project address, electrical configuration, racking system, and price. The database would also collate information with existing equipment databases and with jurisdictional regulatory requirements to create a powerful search engine for database users.
- Having clear, detailed information about low cost systems would result in best practice adoption and process optimization, leading to more widespread system cost reductions. The database would allow for users to verify which systems are the easiest, cheapest, and most efficient to install.
- Since "cost" data has proven difficult to garner as evidenced by projects like OpenPV, price data may be more easily accessible.
- Currently, costs and prices are not transparent to customers, competing installers, or researchers. A database could help to create transparency and level the playing field, driving down system prices in regional markets throughout the U.S.

*Concept Funding, Participants, and Initial Steps*
For the National Solar Database to succeed a broad group of solar energy stakeholders would need to be involved to make sure the process of collecting and uploading system data is simple and does not add time, cost, or complexity to installations. Additionally, in order to collect this detailed level of data in the first place, utilities and state PUCs would need to be involved to an unprecedented degree. Other bodies capable of fostering this dataset could also be approached,

including NARUC, FERC, or perhaps the EIA who could use their statutory authority to partner with a solar friendly nonprofit to collect primary data.

Such an effort could be initially funded by the EIA or Department of Energy while an unbiased nonprofit group or national lab would be the ideal research group to coordinate and launch the database. Initial milestones would focus on a smooth transition from the soon to be lost CSI dataset to a national effort in early 2014. In order to transition from the CSI to a national database without some kind of an information gap, a convening entity would need to quickly begin gathering targeted stakeholder groups to identify what data is worth collecting and what vectors are the most appropriate for data collection. The goal would be for the effort to be fully funded and operational in fiscal year 2015 with full publication of initial data collection occurring by 2016.

**Concept 4: Solar-Ready Standards Campaign**

*Concept Pitch*
A nationally syndicated "Solar Ready" technical certification standard for residential PV systems could help both lower the cost of retrofit installations and encourage homebuilders to include solar systems in new construction. Additionally, a nationally uniform standard evaluation method could create a new class of real estate (similar to LEED in the commercial space) and allow building professionals to quickly and accurately estimate the amount of solar needed for a "Solar Ready" home to achieve net zero energy production.

*Analogous Examples*
USBG LEED Standard, EnergyStar

*Concept Outcomes*
Creation of a nationwide "Solar Ready" standard for new build residential PV construction that goes well beyond the relatively weak state- or city- level solar ready standards of today could provide a variety of benefits to the solar industry, homebuilders, and homeowners:

- Having a nation-wide "Solar Ready" technical standard that includes pre-installed connection points on rooftops could greatly reduce base installation times while pre-installed conduit and/or wire runs based on standard panel configurations could streamline electrical installation and residential system designs.
    - The core technologies of a stringent standard could also include pre-determined roof top attachment and grounding points, plug and play AC electrical connection points, and pre-installed OSHA fall protection points on roof ridges for installation and maintenance.
    - "Solar Ready" homes under this standard could streamline the inspection process, perhaps eliminating the need for local inspections in jurisdictions where audit-only inspections become standard.

    - In addition to lowering installation labor costs, thorough nationwide technical solar ready standards would make engineering planning and site-specific work dramatically easier, resulting in customer acquisition cost reductions and enabling standardization across industry to meet the "Solar Ready" technical standard.
- Such a standard, once elevated to the level of recognition currently garnered by LEED status for commercial buildings, would offer immediate value to a home, not just the promise of future value when a PV system is installed.
    - "Solar Ready" homes would immediately boost the value of a home so long as the standard builds in a baseline level of energy efficiency based on building size and local climate.
    - The standard would identify for aspiring homeowners both an energy efficient building and the lowest-cost possible path towards a PV installation.
- The standard could also enable new, "modular" product offerings.
    - With the appropriate energy efficiency measures and passive solar design strategies verified in a new home under a "Solar Ready" standard, an energy professional could simply and quickly evaluate the solar capacity required to achieve net-zero energy production for any given building. With this evaluation, a homeowner may make an informed decision to be part-load solar or go all the way to net zero.

*Concept Funding, Participants, and Initial Steps*

Multiple avenues exist for the creation and adoption of a national-level "Solar Ready" standard. Initially, an industry-wide collaborative campaign would be required to mobilize the solar industry as a whole on the topic. Accordingly, broad consensus would first need to be garnered amongst large solar developers and integrators. Key outside-industry participants include at least two large homebuilders, USGBC to help with certification development (perhaps in lockstep with residential LEED developments), and the International Code Council. Federal-level legislation could also be pursued to require jurisdictional adoption of specific codes, but this option is unlikely to succeed in the U.S. Finally, a solar-specific trade organization or nonprofit is likely the best candidate to lead the charge for a national "Solar Ready" standard.

Funding models for an organization to shepherd such an effort could include direct funding from all solar industry stakeholder groups including involved banks, tax equity investors, insurance companies, developers, installers, homebuilders, and module & hardware manufacturers. Near term milestones include heavy outreach and coalition building amongst key code bodies and new homebuilders with the goal of alpha technical standards release by Q2 of 2014.

## Next Steps

In order to further explore these concepts, solicit additional feedback, and gauge industry interest, RMI will be hosting an interactive webinar on November 21st, 2013. During this webinar, we hope to further downselect from these concepts in order to prioritize our efforts moving forward and identify champions from industry able to take the lead on one or several of the concepts. In addition to participants from the soft cost impact forum, RMI will be inviting several other solar industry participants to the webinar who have expressed interest in the effort.

For more information on the webinar, visit http://www.rmi.org/solar_road_map. Please direct any additional inquiries to Eric Wanless, ewanless@rmi.org.

## Soft Cost Impact Forum Participant List and Contact Information

| Name | Company / Organization | Email |
|---|---|---|
| Alex Huang | North Carolina Solar Institute | aqhuang@ncsu.edu |
| Brian Mehalic | Solar Energy International | brian@solarenergy.org |
| Chad Medcroft | Zep Solar | chad@zepsolar.com |
| Chris Klinga | Lumos Solar | cklinga@lumossolar.com |
| Cody Kyber | SunPower | dakota.kyber@sunpowercorp.com |
| Stan Pipkin | Lumos Solar | spipkin@lumossolar.com |
| Constantino Nicolaou | Panelclaw | cnicolaou@panelclaw.com |
| Francis O'Sullivan | MIT | frankie@mit.edu |
| Jesse Morris | Rocky Mountain Institute | jmorris@rmi.org |
| Joseph Goodman | Georgia Tech Research Institute | joseph.goodman@gtri.gatech.edu |
| Justin Baca | Solar Energy Industries Association | jbaca@seia.org |
| Koben Calhoun | Rocky Mountain Institute | kcalhoun@rmu.org |
| Luis Rangel | SunPower | luis.rangel@sunpowercorp.com |
| Scott Franklin | Lumos Solar | sfranklin@lumossolar.com |
| Wolfgang Schliting | Wolf Research | wschlichting@wolfresearch.net |

## Appendix A: Installation Labor Group Discussion Summary

Before building out specific concepts with the potential to help industry reduce installation labor and other soft costs, impact forum participants explored a number of different issues and potential paths forward, summarized below:

- **Currently, incentives are misaligned within solar installation and integration companies resulting in expensive, inefficient, and sub-optimal system designs and installations.**
    - Typically, sales teams are compensated based on the size of systems sold, not on how much energy a system produces to meet any particular building's energy demand. This incentivizes sales teams to sell on a maximum capacity basis, oftentimes resulting in system designs that require multiple arrays in suboptimal orientation or complex designs that utilize the maximum amount of rooftop space possible.
        - Such designs incur higher installation costs, especially for the "last module" required to hit a certain capacity target. Realigning incentives and encouraging sales crews to sell energy, not capacity—perhaps through modular product offerings that allow customers to expand their solar system at different points in time, could help lower installation labor and customer acquisition costs.
    - Adding to the problem is a general lack of effective project management tools for solar PV installers and integrators.
        - Currently, few tools exist that allow sales teams, system designers, and construction crews estimate, with any degree of accuracy or specificity, how much construction might cost at a given job given contextual parameters including roof pitch, composition, orientation, local wind / snow load requirements, and logistical constraints.
- **Most PV-specific training programs do not currently emphasize installation efficiency.**

- Instead, emphasis is placed on quality and system reliability—both keys to the successful long-term operation of any given PV system. However, ample opportunity exists to incorporate installation efficiency training into existing training curriculum.
- "Efficiency of design" should also be taught to individuals throughout PV companies—not just construction crews. A "Solar MBA"- like curriculum catering to sales teams and mid- to high-level solar professionals that frames solar as an energy management service, not a capacity-based appliance, could help to improve and clarify the customer value proposition, lower installation costs, and help installers and integrators better align their staff—from the procurement team to the operations and maintenance crew.

- **Both inter- and intra- company competition could help increase efficiency and lower costs.**
  - Sponsored "X Prize"-like events focused on installation efficiency could foster competition between firms, while benchmarked competition amongst crews within companies could also help establish company-wide cultures focused on installation efficiency and low cost. Such company-wide cultures have been successfully cultivated in other industries and could provide a model for the solar industry (i.e. private line haul trucking fleets).
    - Furthermore, participants suggested the creation of an annual "J.D. Power" - equivalent prize for a quality, reliable, and low-cost efficiently installed system from a reputable, widely recognized trade association or brand.
- **While some progress has been made in particular jurisdictions and markets, permitting and inspection costs are still an issue.**
- **Building codes and solar ready standards have the potential to help lower soft costs.**
  - Wind and snow load requirements are the primary driver behind "over-engineered" system designs and onerous inspections. The

solar industry should partner with the International Building Council or other rulemaking bodies and take a hard look at these requirements to re-think their specific application on a case-by-case basis.

        - A publicly available database with product by product wind testing results would help overcome challenges associated with the status quo.
    - A nationwide effort to create a solar requirement for new-build systems (or at least a solar ready standard that does more than require contractors to inform homeowners that solar is an option, as is the case in Colorado) would greatly increase installed capacity nationwide and help industry move even further towards standardized designs.
- **Standardized system designs with integrated componentry based on a widely understood solar-specific language represent a massive leverage point to help reduce installation labor, hardware, system design, and customer acquisition costs.**
    - An RS Means or Automotive Flat Rate Structure-like language specific to rooftop solar PV installations would help installers develop clearer bids for installations and better understand where costs can be shed.
    - Such a language would also clearly highlight opportunities for hardware integration to further streamline installation labor and reduce hardware costs.
    - While $/W is a useful metric, it may not be the correct one for a solar domain specific language.
- **Publicly available information and analyses similar to Simple BoS are useful and should continue to be made available, especially if it contributes to the creation of a standard rooftop installation language.**
    - International comparisons are useful, but instead of comparing Germany to the U.S., compare the U.S. to all of Europe.

    - Best practice publication and efficiency-specific installation training that highlights the benefits of task specialization and standard operating procedures, perhaps offered through a Solar Center of Excellence, would help reduce costs further.
- **Developing market specific products for different geographies, rooftops and markets could help speed installations further.**
    - Aggregating customers on a neighborhood-level and selling systems with standard system designs catering to local characteristics (roof composition, orientation, layout etc.) can enable low cost residential bids.