Woodlawn Associates

Management Consulting

Solar Installation Effectiveness

September 10, 2012

C O N F I D E N T I A L

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Revision d

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About Woodlawn Associates

- **Management consulting firm with significant experience in solar:**
  - Go-to-market and business strategy for vendors
  - Residential solar finance
  - Residential dealer business strategy
  - Competitive analysis
- **Offices in Chicago and San Francisco**

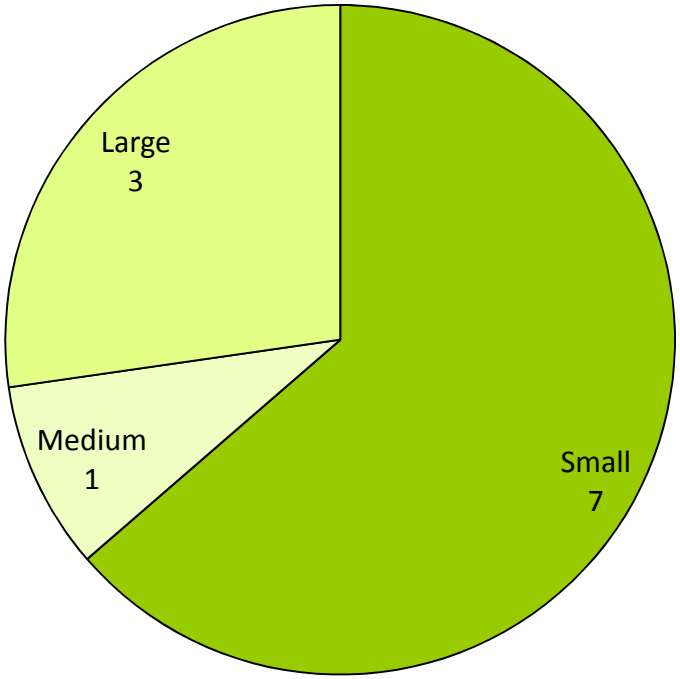
Executive summary

- **Woodlawn collected, reviewed, and analyzed financial and operational data for 11 U.S. residential solar installers for the 12 months ending June 30, 2012**
- **Dealers spent an average of $3.69 / Watt on installations**
  - They spent $3.79 / Watt adjusted for whether they purchase inverters and modules for leases
  - Excluding modules and inverters, average installation cost was $2.16 / Watt
  - The largest component of cost ex modules and inverters is labor, at $1.12 / Watt
- **By matching low cost dealers in each category, dealers could install for $2.13 to $2.59 / Watt**
- **Dealer gross margins averaged only 20% of revenue**
  - We used a standard set of costs across all dealers to ensure comparability
- **Use of microinverters appears to decrease design costs by about $0.06 / Watt**
- **Variability and uncertainty in the installation timeline drives up labor cost and inventory**
- **Dealers can reduce costs by following the 19 recommendations summarized on page 51**
- **To win loyalty and pricing power, vendors should focus on predictability**

Notes: Except where noted, all costs in this document are in $ / Watt DC at STC.

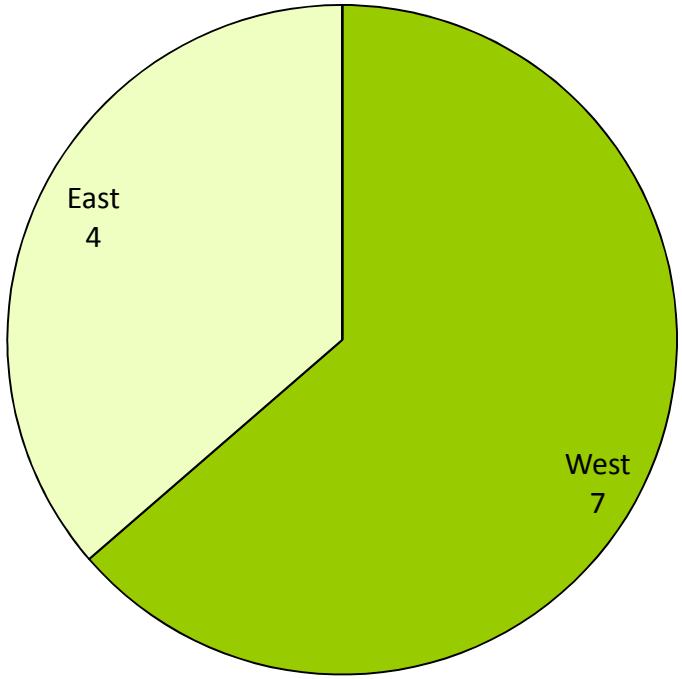
Detailed financial and operating data provided by 11 co-sponsoring solar dealers

Dealer Size

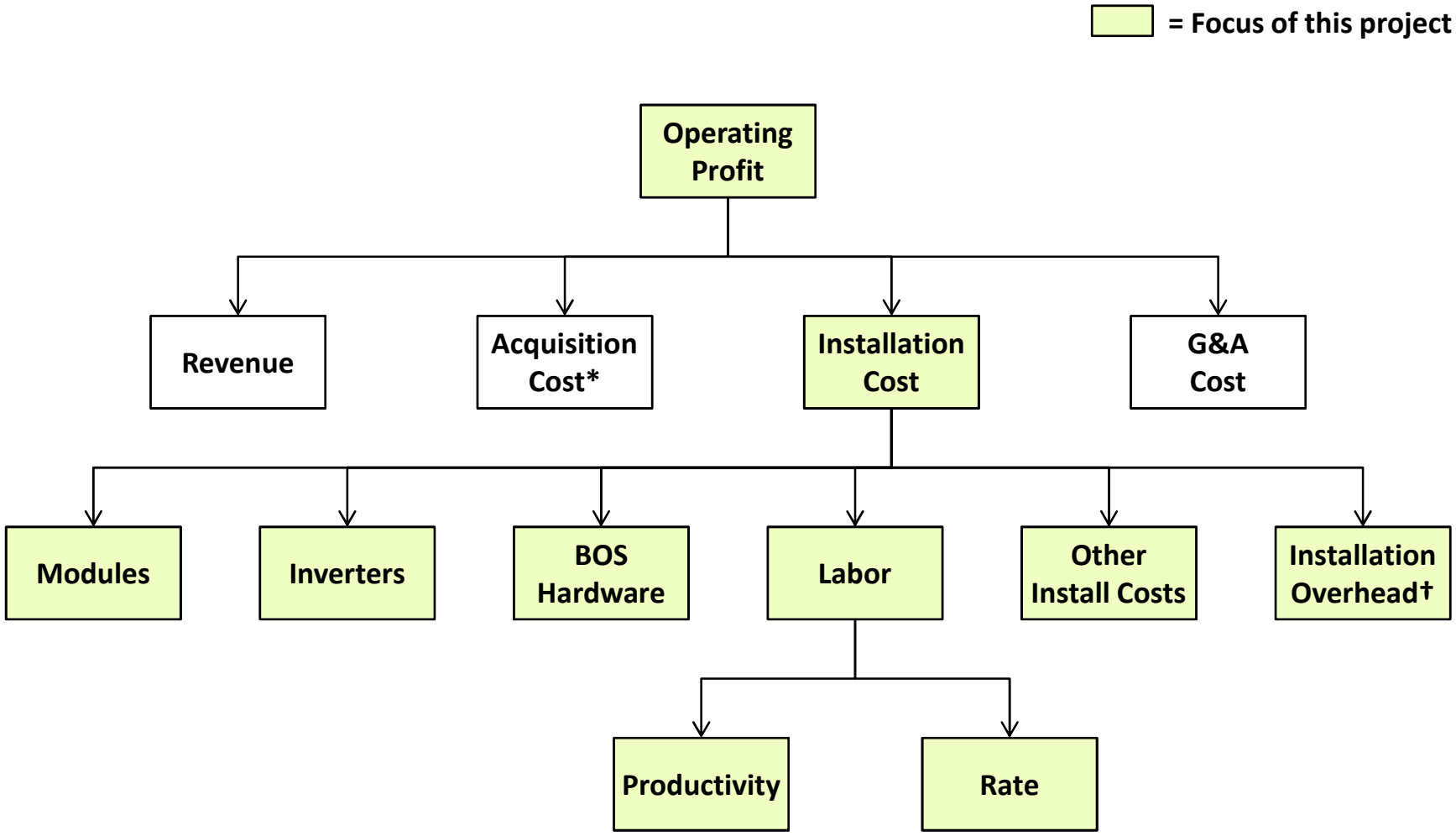


Category	Systems Sold / Month
Small	<15
Medium	15-49
Large	50+

Primary Dealer Geography



Installation cost is one of four major profit levers for solar installation businesses



Notes: * Acquisition cost was the focus on an earlier Woodlawn project, Solar Marketing Effectiveness, published in March 2012.
Some dealers also internally provide lease and PPA financing, creating a fifth lever on operating profit.
† Occupancy expenses (for example, for a warehouse), IT attributable to operations, and operations management employment costs.

Woodlawn used the following definitions for this project:

Revenue

Less: Installation Cost (a.k.a. Cost of Sales, Cost of Goods Sold)

- Modules
- Inverters
- BOS hardware (racking, cabling, monitoring, etc.)
- Sales taxes paid*
- Freight
- Labor
- Subcontract labor/services
- Workers' compensation insurance
- Tools and installation-related IT
- Permit and application fees
- Vehicle and travel expense
- Equipment rental
- Warranty expense or reserve
- Installation-related overhead

Gross Margin

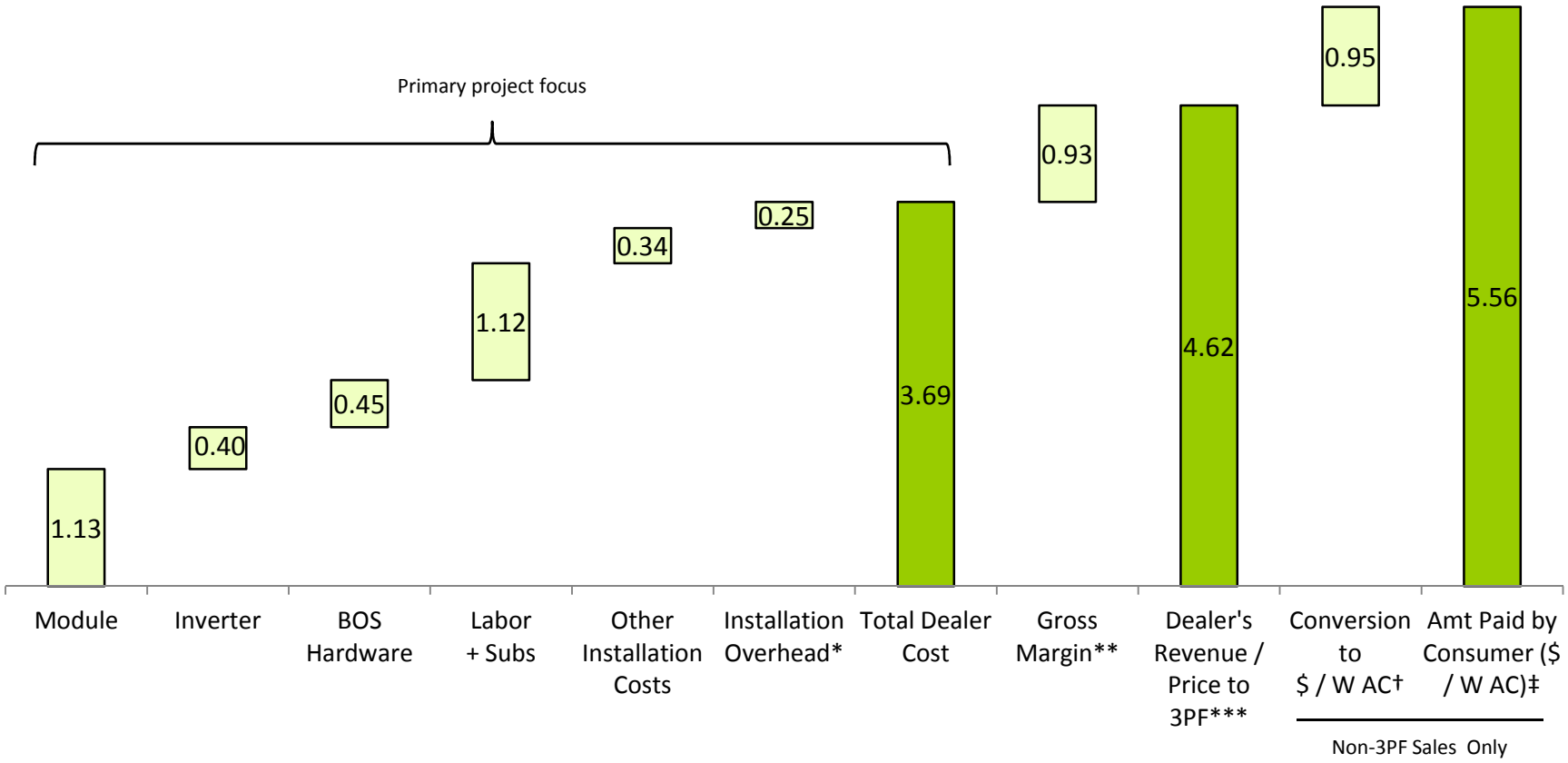
Less: SG&A

Operating Profit

Notes: * Sales/use taxes paid by the dealer. Sales and use taxes payable by consumers or other downstream customers but collected by the dealer are excluded from both COGS and revenue.
Only the installation-related portion of expenses are included in installation cost.
SG&A includes sales, marketing, performance bonds, training, general liability insurance, and all other expenses.

The primary focus of this project is dealers' internal installation economics

Breakdown of Average Cost of Goods Sold (and Price)
($ / Watt DC except as noted) (12 months ending June 30, 2012)

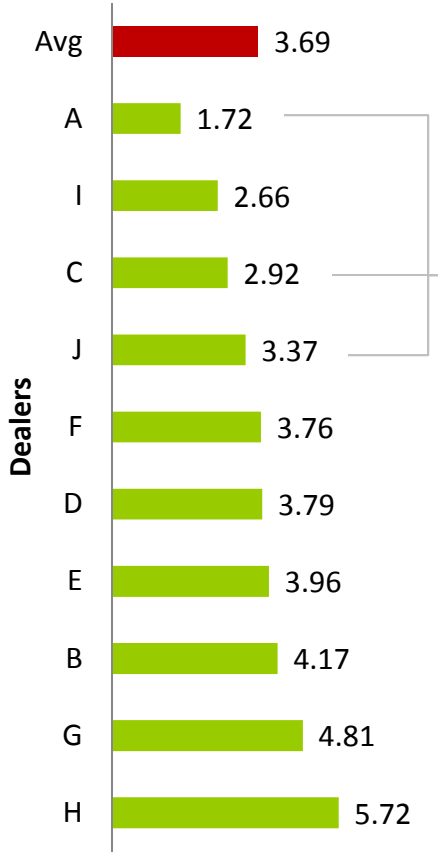


Notes: * Occupancy expenses (for example, for a warehouse), IT attributable to operations, and operations management employment costs.
** A dealer's profit is this gross margin minus sales, marketing, and G&A expenses
*** Third Party Finance company
† Assumes AC Watts = DC Watts * 0
‡ Excluding any sales tax payable by consumer

Contents

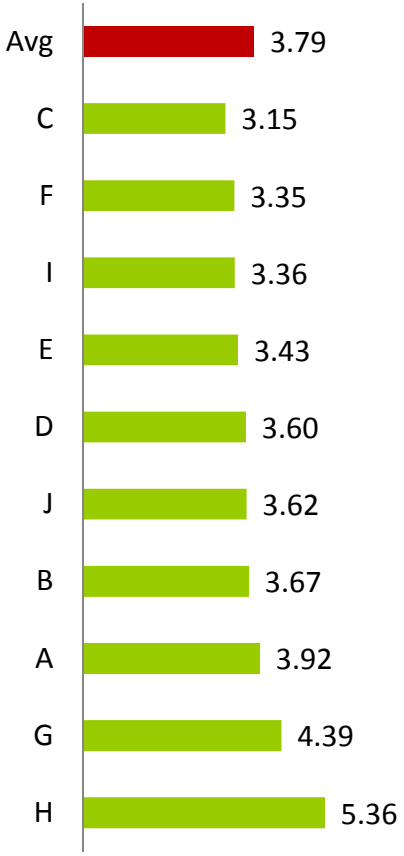
Dealers spent $3.69 per Watt on installations, or $3.79 adjusted for purchasing approach and timing

Cost of Goods Sold ($ / Watt)



- **Cost of Goods Sold represents dealers' actual expenses to perform installations, as reflected in their financials**
  - Includes the standard set of costs defined on page 7
  - For lease sales, dealers A, C, and J did not purchase modules or inverters (their third-party finance partner did so)
  - Other dealers sometimes installed inverters that were purchased by third party finance providers
- **Adjusted Installation Cost reflects the overall cost of installations as if the dealers had bought all the modules and inverters they installed**
  - Used the prices dealers paid in the past 30 days
- **Both figures include installation-related expenses from contract to interconnect**
  - Not simply the cost incurred at the house

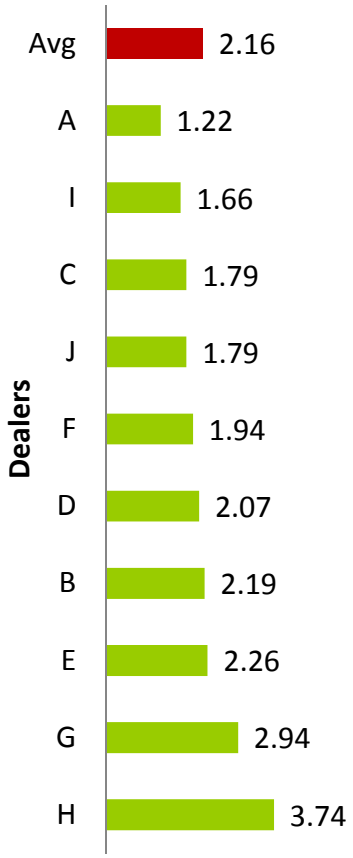
Adjusted Installation Cost ($ / Watt)



Modules and labor were essentially tied as the largest installation-related costs

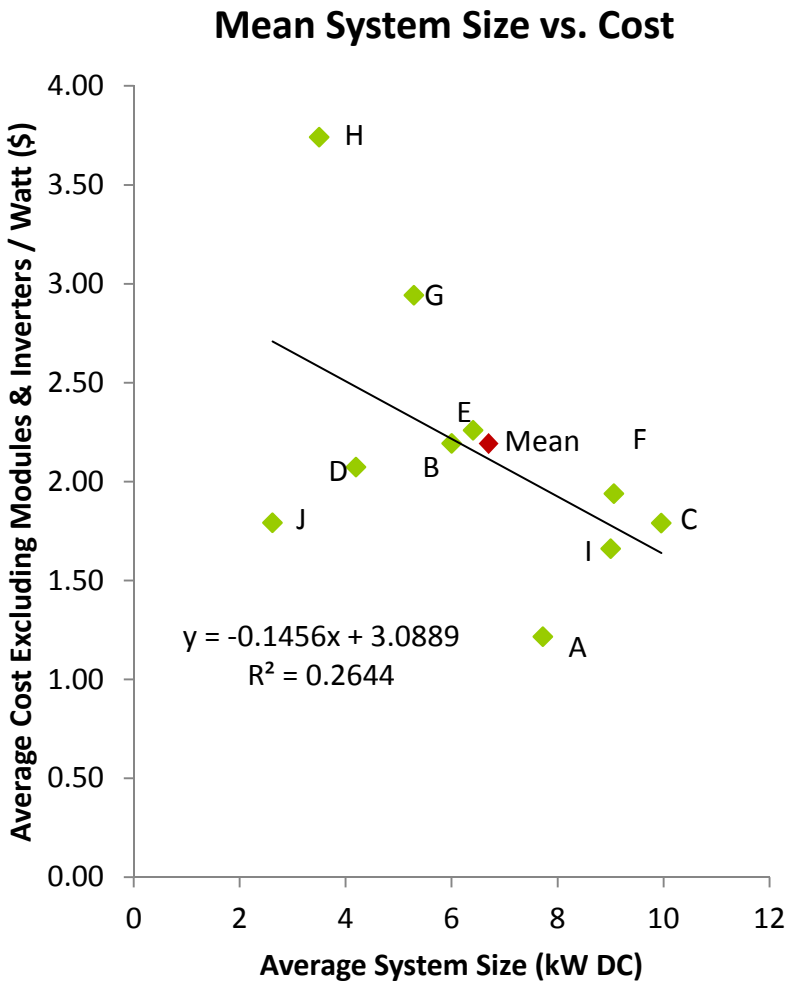
Excluding modules and inverters, dealers spent $2.16 per Watt for installation

Cost Excluding Module & Inverter ($ / Watt)



- **On average, installation cost excluding modules and inverters totaled $12,942 per system**
- **Dealers A, C, and J installed kits that were delivered as a package. Their overhead expenses were low**
  - Dealer C did not even have a warehouse or offices until late in the study period
- **Dealers A, I, and C were among the four dealers with the largest average installed system size**
  - See relationship between system size and cost on next page
- **There is no sales tax in the states where dealers I and C do business**
  - Overall, dealers spent an average of $0.07 / Watt on sales tax
- **Dealers A and J did a substantial number of new home builds**
  - They had the lowest and third-lowest permitting labor expenses, respectively
- **Dealers I, C, and J have their installation crews work four 10-hour days**
  - They have among the lowest vehicle costs
- **Dealer A was the only dealer to use a three-man on-site crew and had a much lower wage rate than other dealers**
  - Paid only $15 / hour compared to overall average of $28/ hour

Unsurprisingly, dealers who installed larger systems achieved lower cost / Watt



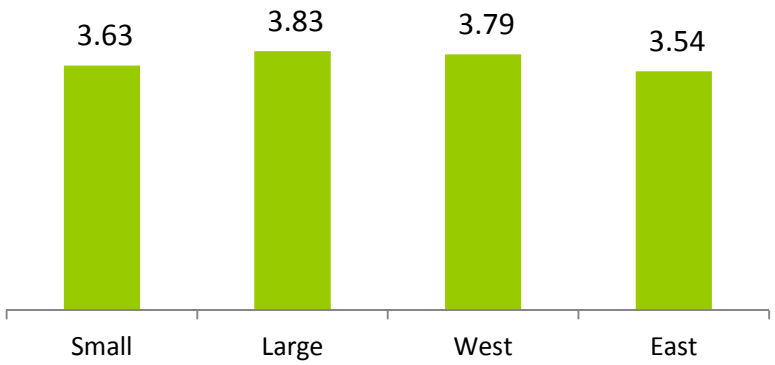
- **Installing larger systems allows dealers to spread out fixed costs (such as permit applications fees) and semi-fixed costs (such as cost of design and project management) over a larger base**
- **The data suggests increasing average system size by 1kW would decrease cost by $0.15 / Watt**
- **However, maximizing the system size for a given household may not be optimal for third-party owners**
  - If homeowner moves or reduces consumption, the lease contract may be less attractive in the future
  - Or, if PPA, system owner may see lower than expected payments
- **Therefore, ideal solution would be to sell large systems to high-consumption homeowners that nonetheless satisfy only a fraction of their total demand**
  - Even if future consumption at the building is lower, the solar system will still be a good value for the homeowner and finance company

Notes: Mean not included in regression data.

On average, small dealers had lower COGS because vendors assumed some hardware costs

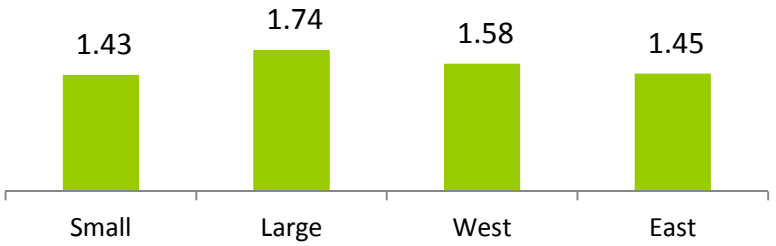
1 **Cost of Goods Sold ($ / Watt)**

It appears small dealers achieve lower costs…



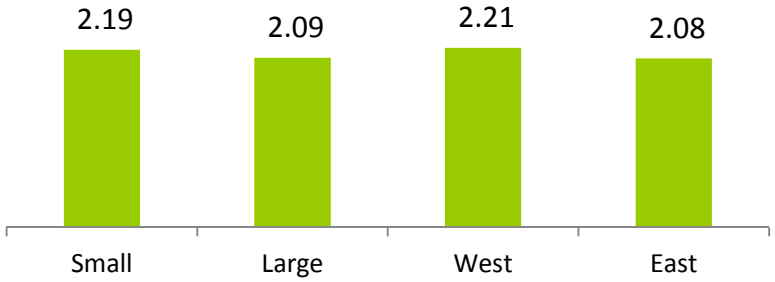
2 **Module + Inverter Cost on Books ($ / Watt)**

…driven by lower expenses for key raw materials…



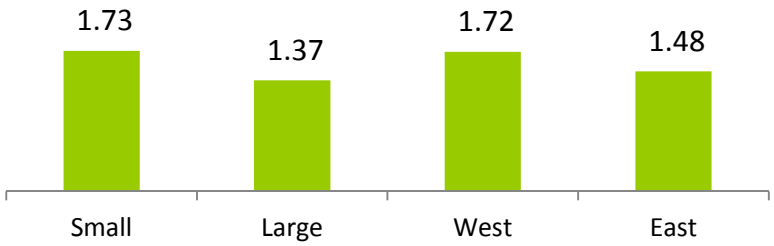
3 **Installation Cost Excluding Modules & Inverters ($ / Watt)**

…while other costs are very similar…



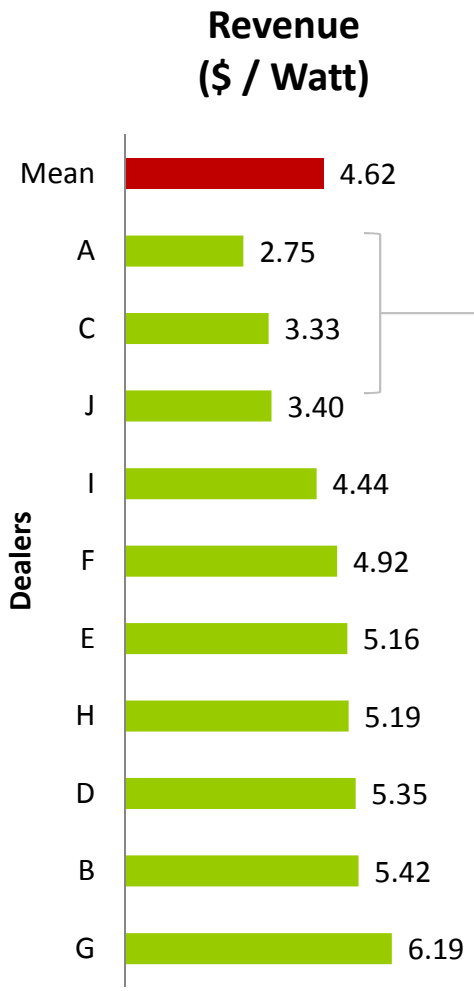
4 **Module + Inverter, Past 30 Days ($ / Watt)**

…but, when small dealers purchase all materials they actually pay $0.36 more than large dealers.*

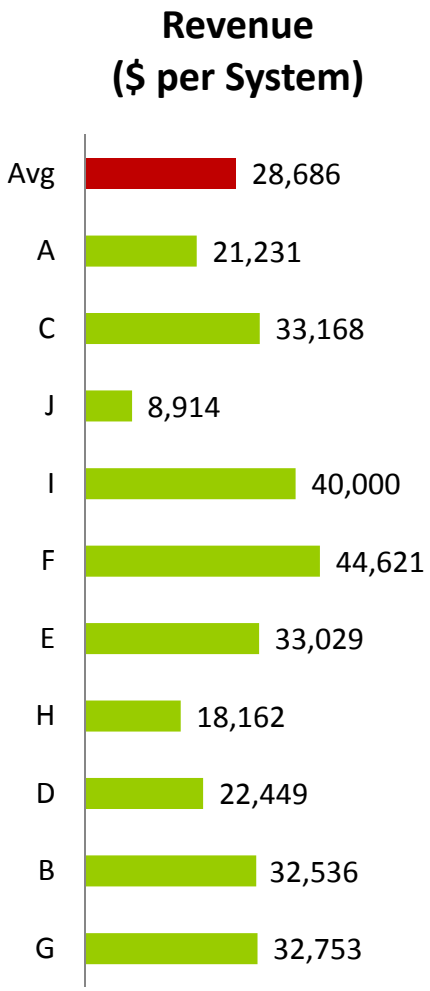


Notes: "On Books" data reflects costs on dealers books divided by number of Watts installed. This does not reflect full system costs because 3rd party financiers buy some hardware for dealers.
* $0.19 when excluding SunPower modules.

On average, dealers collected $4.62 in revenue for each Watt installed, or about $29,000 per system

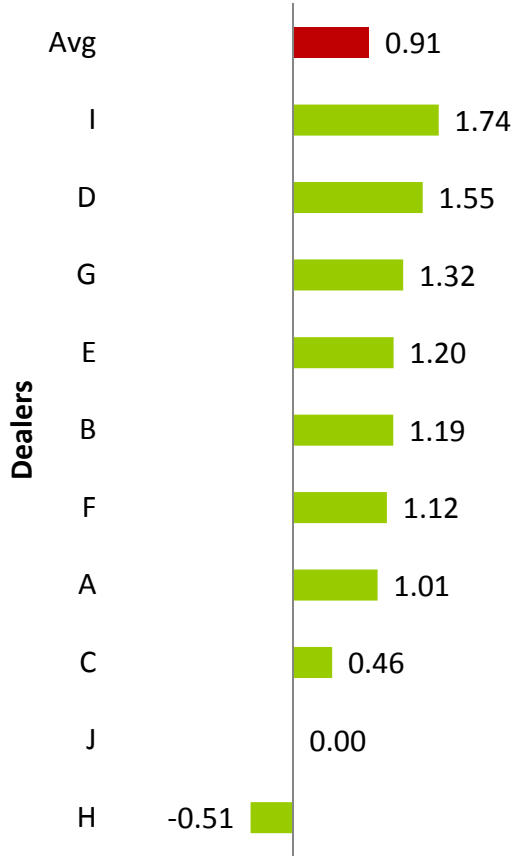


- **Dealers A, C, and J don't record revenue for modules, inverters, or racking on lease sales**
  - Some other dealers do not record revenue for inverters on leased sales they do with third parties
- **Dealer J also does a lot of very small systems on new homes**
  - Typically 1-3kW
- **Dealer G is in a relatively small market and probably has less competition than dealers in many other markets.**
  - All of its sales are cash



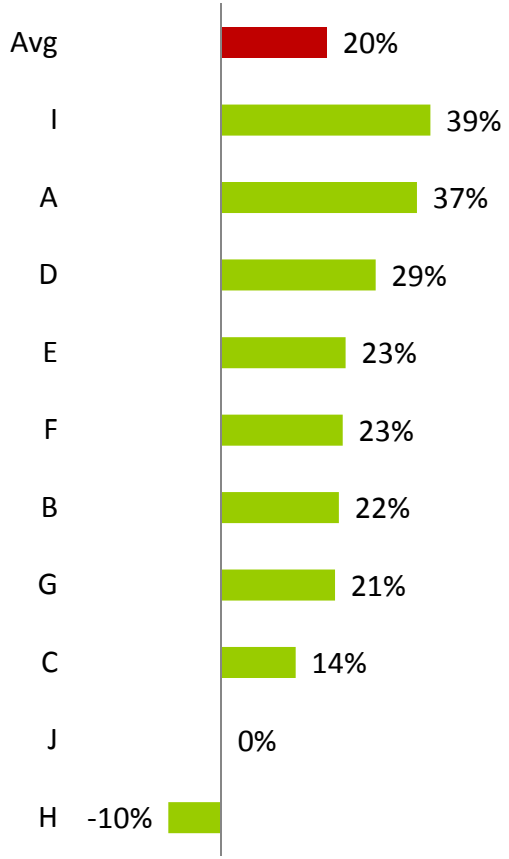
Dealer gross margins averaged only 20%

Gross Margin ($ / Watt)



- **Gross margin calculated as revenue less standard set of installation-related costs**
  - Costs defined on page 7
  - Each dealer had a different approach to accounting for warranty expenses (see page 47), so we assumed 1% of revenue as a standard warranty expense reserve and applied this to all dealers
- **In *Solar Marketing Effectiveness*, we determined the average dealer spends 17% of revenue on customer acquisition, suggesting the typical dealer may not be profitable after subtracting sales, marketing, and general and administrative costs**

Gross Margin (% of Revenue)



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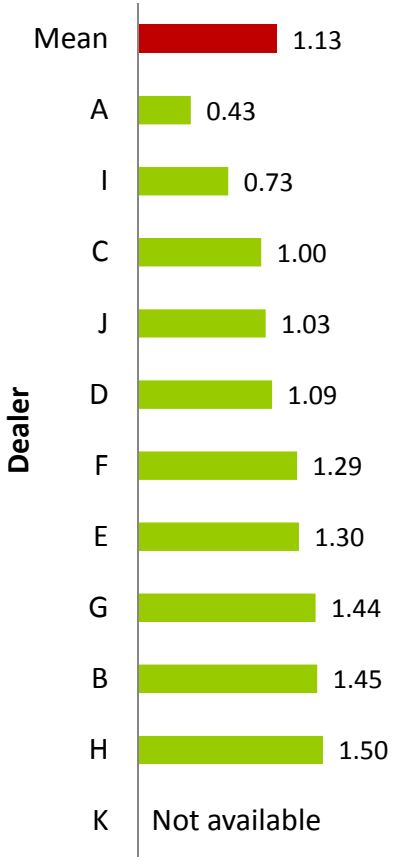
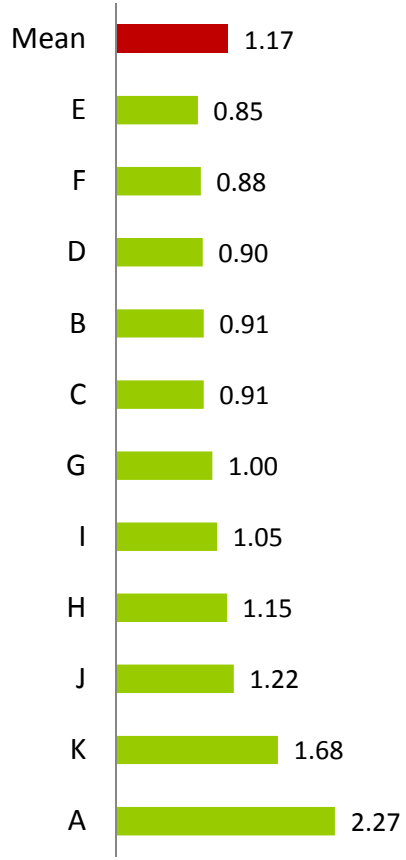
Dealers paid an average of $1.17 per Watt for modules as of August 2012

Module Cost, 12 Months ($ / Watt)



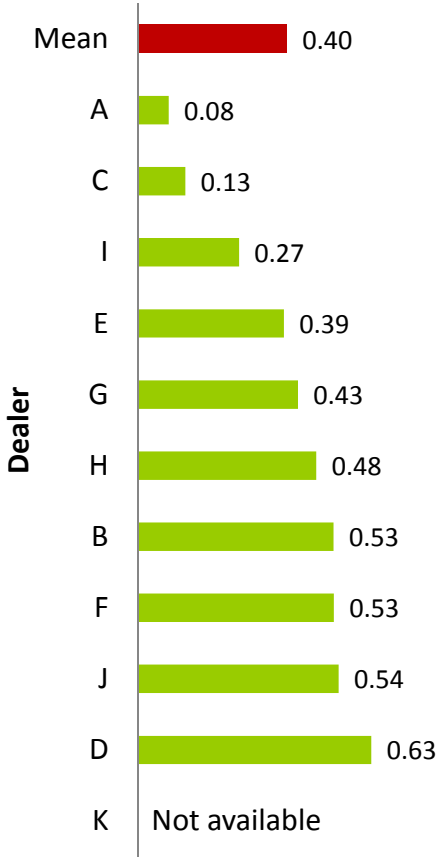
Module Cost, Past 30 Days ($ / Watt)



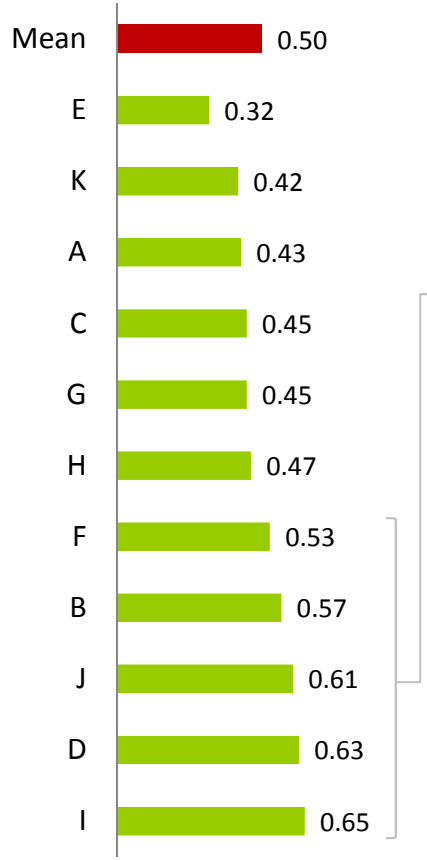
- **12 month data represents the actual module expense on dealers' books divided by number of Watts installed**
  - Does not represent comprehensive installed cost as seen by the consumer as some dealers do not purchase modules for leased systems
  - Timing of dealer purchases of module inventory (if any) may also cause cost to deviate from expected costs
- **One dealer had a significant inventory write-down, highlighting the importance of moving inventory quickly, especially when prices may change quickly**
- **30 day data represents the price dealers say they paid for modules they bought most recently**
- **Dealer size impacted the prices paid for modules**
  - Large dealers typically paid $0.34 less per Watt ($0.16 less per Watt excluding SunPower modules)

Dealers paid an average of $0.50 per Watt for inverters as of August 2012

Inverter Cost, 12 Months ($ / Watt)

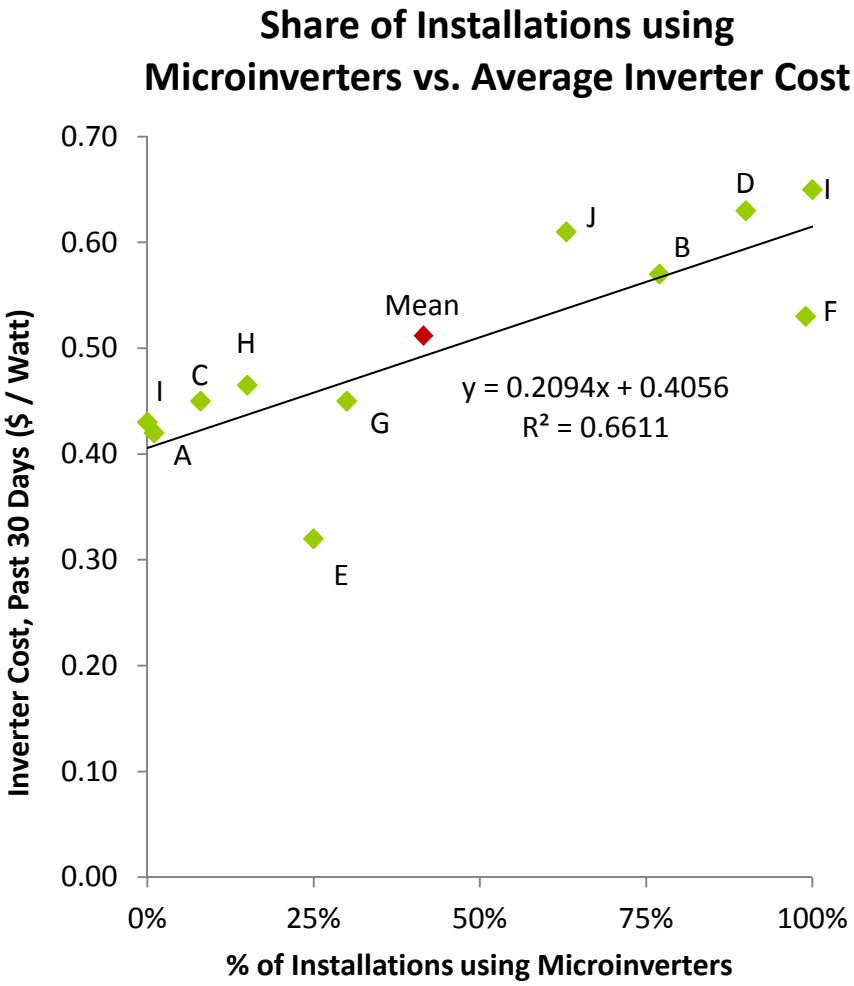


Inverter Cost, Past 30 Days ($ / Watt)



- **Same notes apply to 12-month inverter cost data as for module cost**
  - Some third-party finance companies purchased inverters in 2011 to access 30% Treasury grants
  - Certain finance providers continue to purchase inverters directly
- **Dealers at the top end of the 30-day cost scale use microinverters more than 50% of the time**
  - Dealers F, D, and I believe micros allow them to save on design costs
  - Dealer F believes micros help with inventory management as there is only one SKU stock
  - Dealer D believes micros will result in fewer maintenance calls over time, as it believes module soiling will have less of an impact
  - Dealer B says micros help it win sales against SunPower dealers
- **See impact of microinverter use on dealer labor expense on following pages**

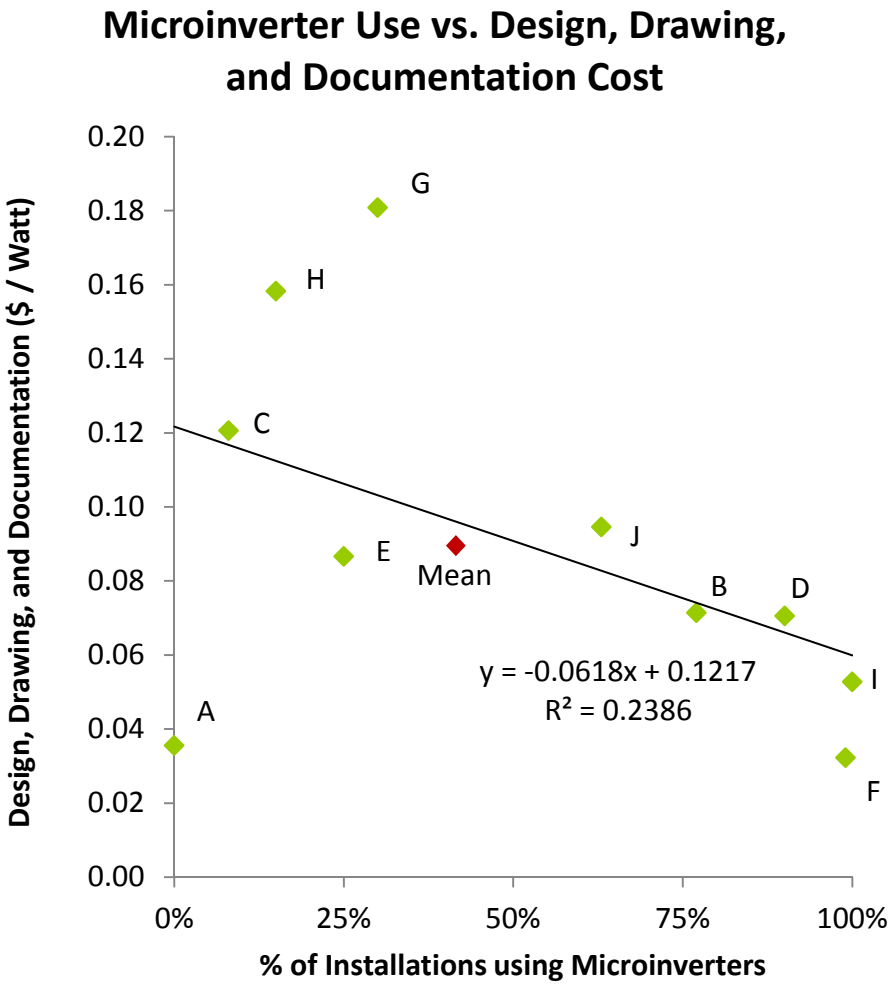
Microinverters carry a premium of about $0.21 per Watt



- **On average, dealers are using microinverters in 46% of their installations***
- **We would expect the average dealer using no microinverters to pay $0.41 / Watt, while we would expect the average dealer using all microinverters to pay $0.62 / Watt**

Notes: Mean not included in regression data.
* This is a arithmetic average of microinverter use by each dealer. It is not weighted by dealer size, although there were large dealers in both camps.

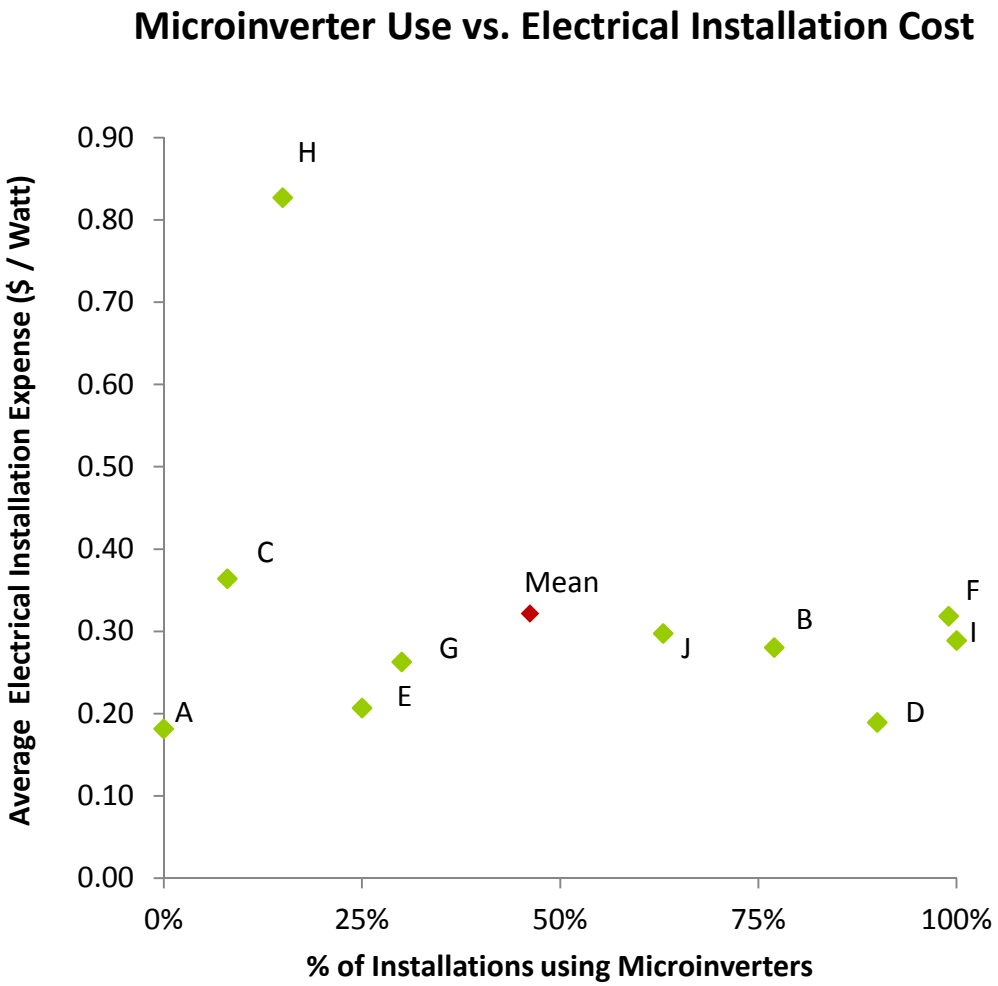
Microinverters apparently helped reduce design costs by $0.06 per Watt, partially offsetting their price premium



- **Dealers with high use of microinverters typically report lower costs for system design, drawing, and documentation**
  - "You don't have to do string calculations or iterations of how many panels you can fit." Dealer M
  - "We have already eliminated one person and one step in the design process by making that change." Dealer D
- **On average, we would expect a dealer using no microinverters to spend about $0.12 / Watt on this task, whereas we would expect one using all microinverters to spent $0.06 / Watt**
- **The fit of the data is fairly lose**
- **Net of the labor savings, microinverters are priced about $0.15 / Watt above conventional inverters**

Notes: Mean not included in regression data.

However, microinverter use seemed to have no relationship with electrical installation expense



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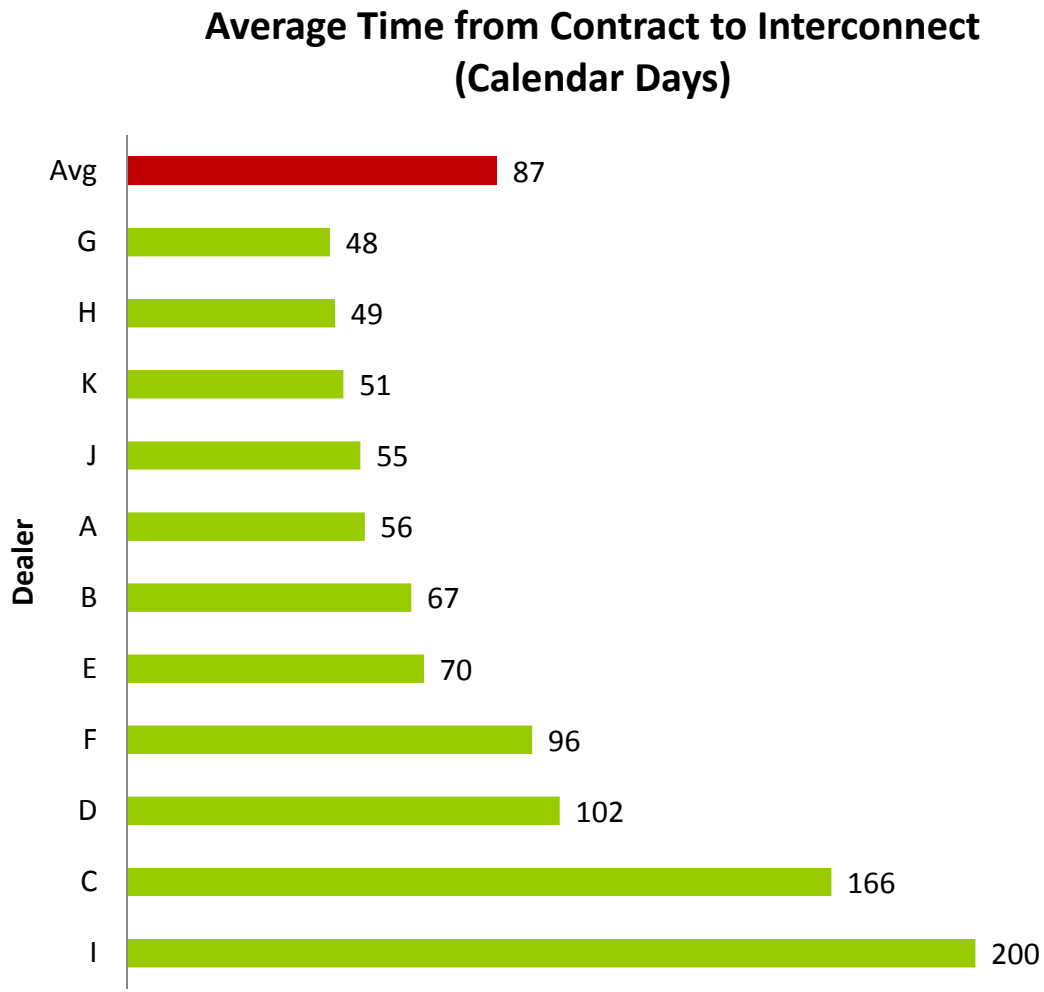
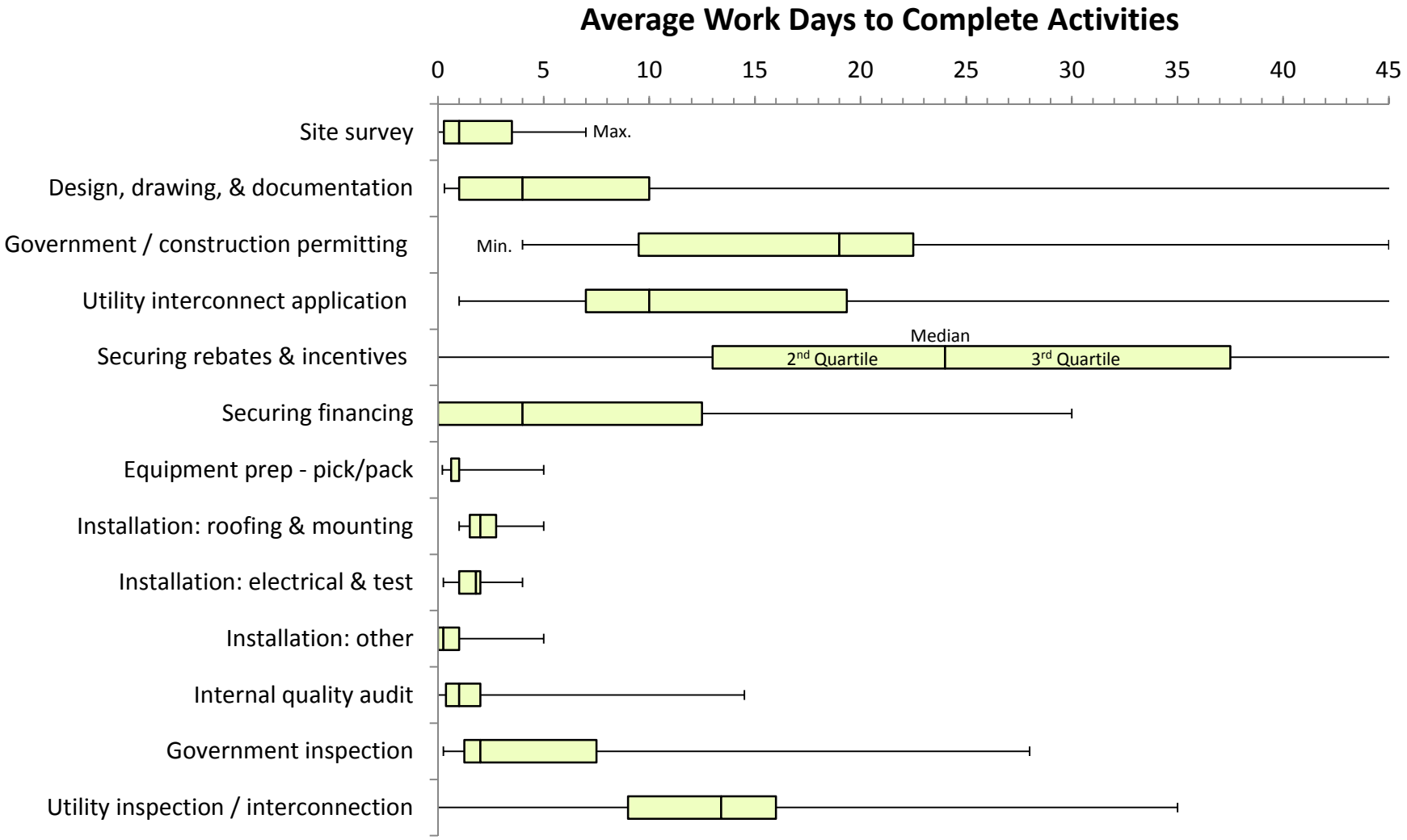
Average calendar time from sale to interconnect was 87 days

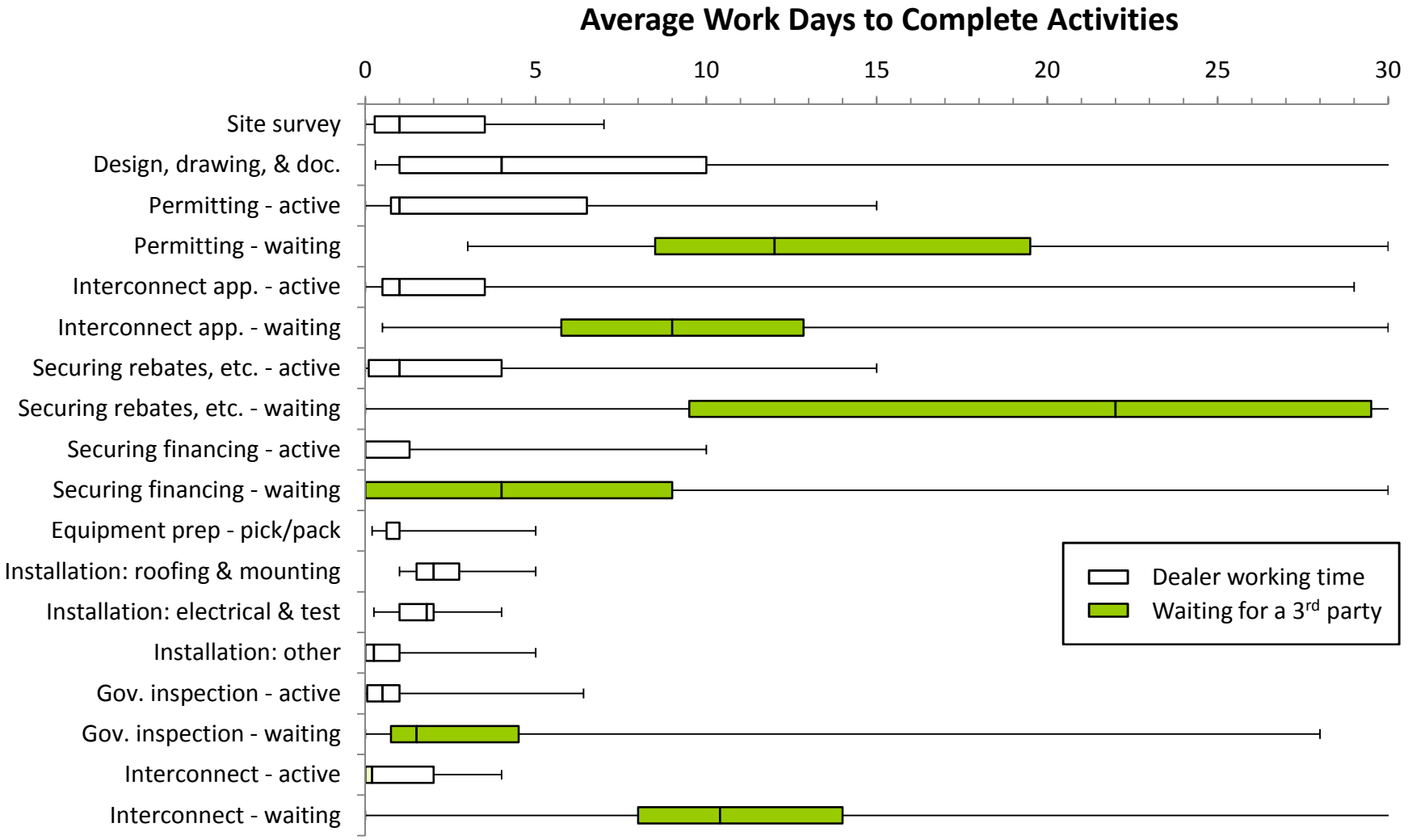


The average elapsed time to complete each activity varied significantly across installers



Notes: n=11; Work days are non-weekend, non-holidays. For most companies working days are approximately 2/3 the number of calendar days.
Chart based on each dealer's mean time to complete a task. Within a single dealer, time to complete certain tasks varied significantly from project to project.

Waiting for third parties adds up to 59 work days to the average installation timeline

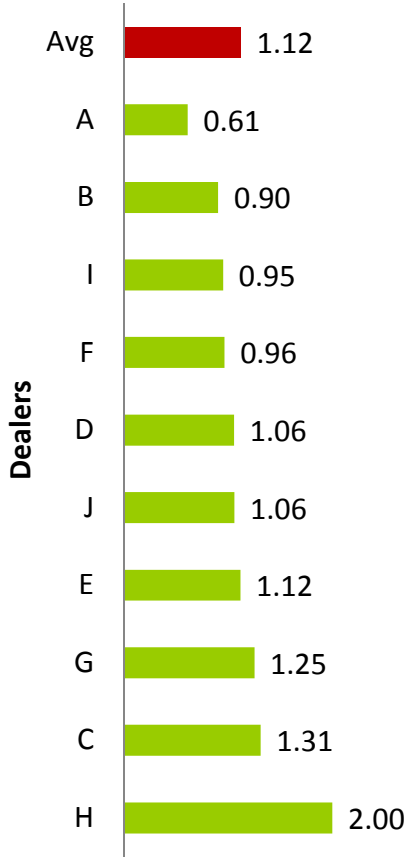


Notes: n=11; Working days are non-weekend, non-holidays. For most companies working days are approximately 2/3 the number of calendar days.
Chart based on each dealer's mean time to complete a task. Within a single dealer, time to complete certain tasks varied significantly from project to project.

Contents

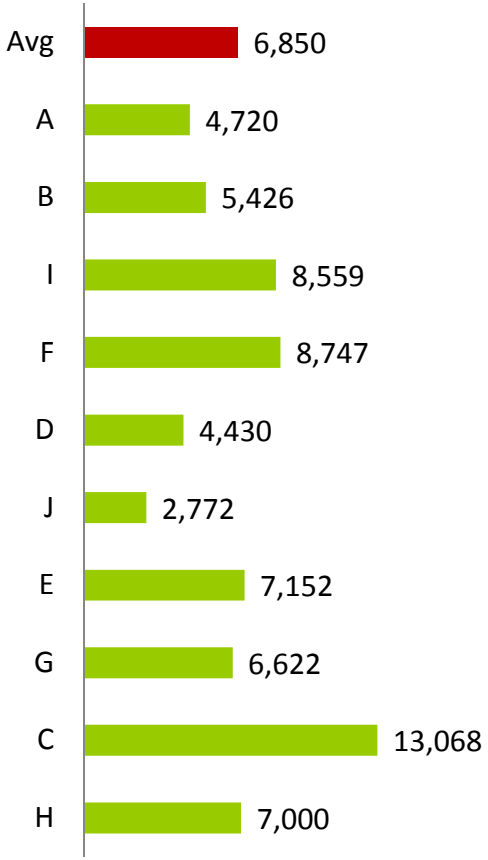
Labor was the largest single installation-related cost, at $1.12 / Watt

Labor + Subcontracting ($ / Watt)



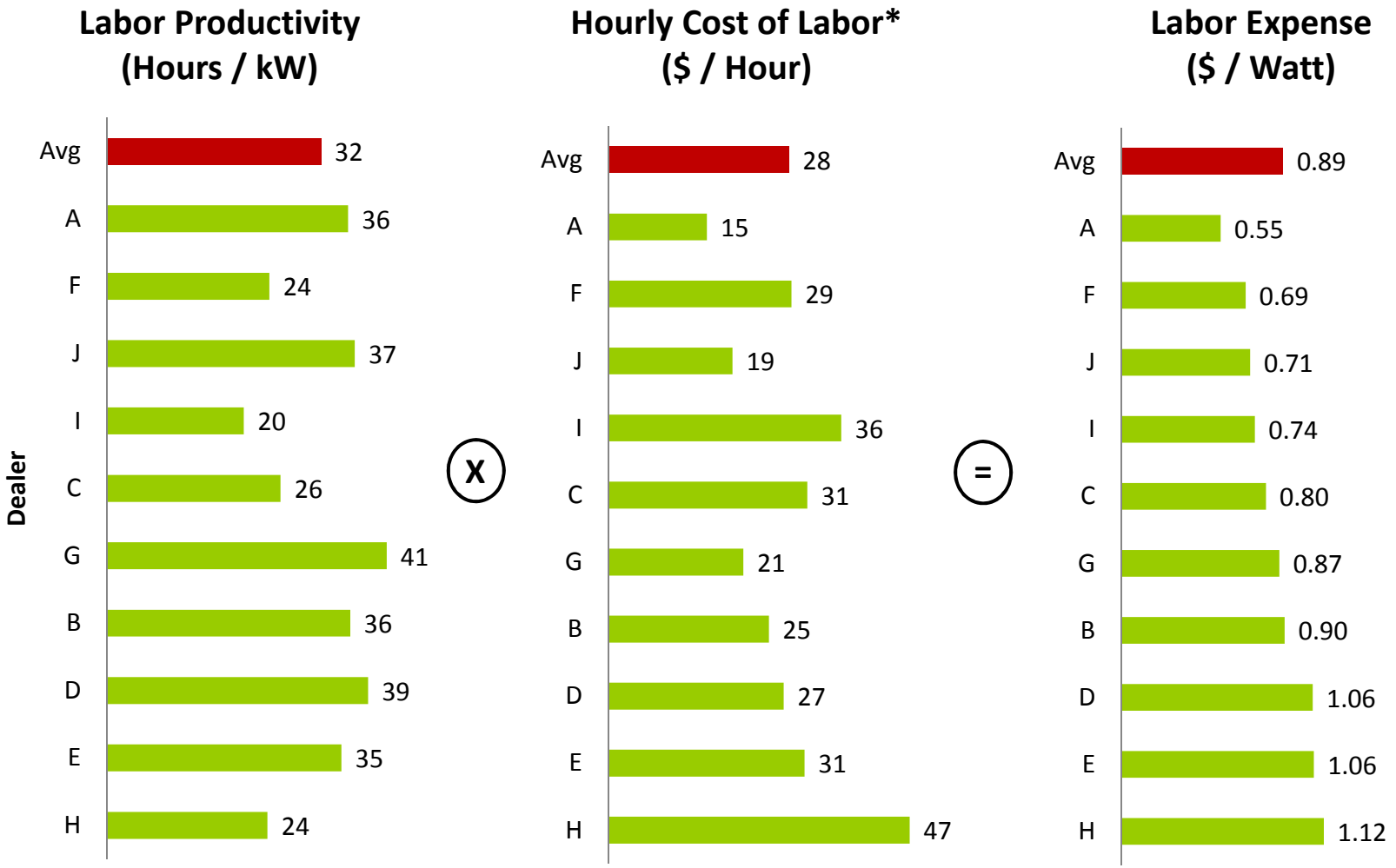
- **Labor cost comparisons remove other items in overall cost that make comparisons difficult**
  - Whether dealers purchases hardware or not (for third party leases)
  - Assumptions about allocations to overhead
  - Sales tax that varies by jurisdiction
  - Differences in warranty reserves
- **Labor is a large expense**
  - 30% of overall cost
- **High variance among dealers, suggesting significant opportunity for optimization**
  - Dealer with lowest labor costs was $1.39 / Watt below dealer with highest

Labor + Subcontracting Cost ($ / System)



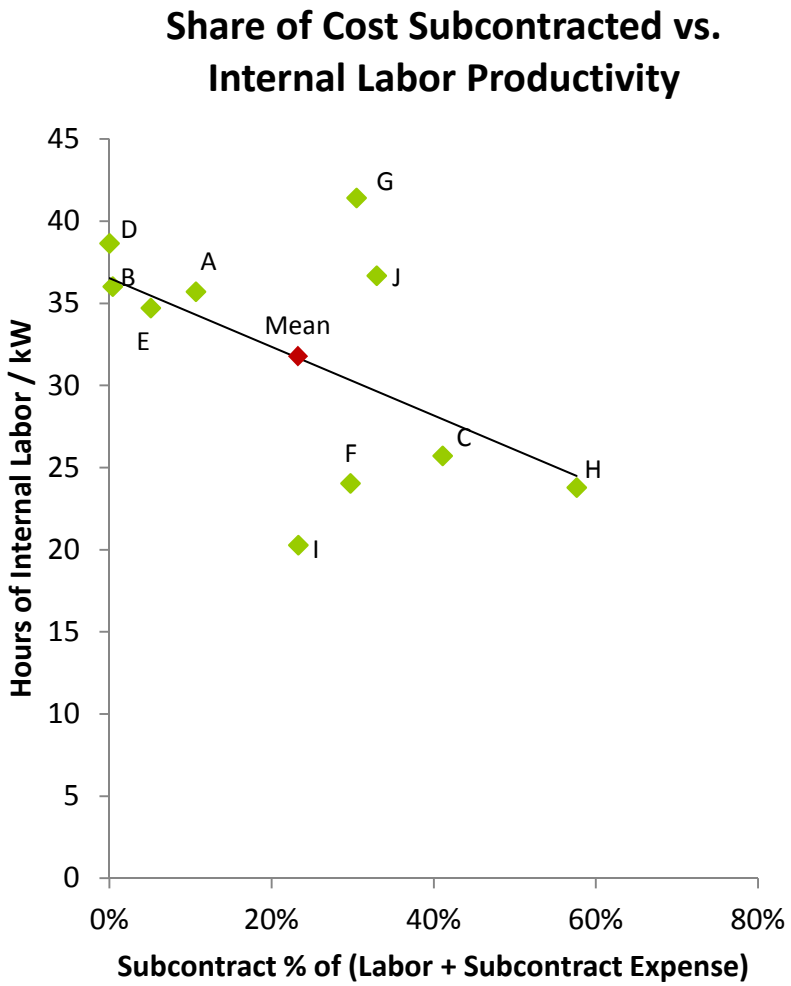
Notes: Including salaries, wages, variable compensation, employment taxes, benefits, workers' comp. insurance, and subcontractors.

Dealers can manage their own labor expense by focusing on productivity or compensation



Notes: *Salaries, wages, variable compensation, employment taxes, benefits, and workers comp. insurance.

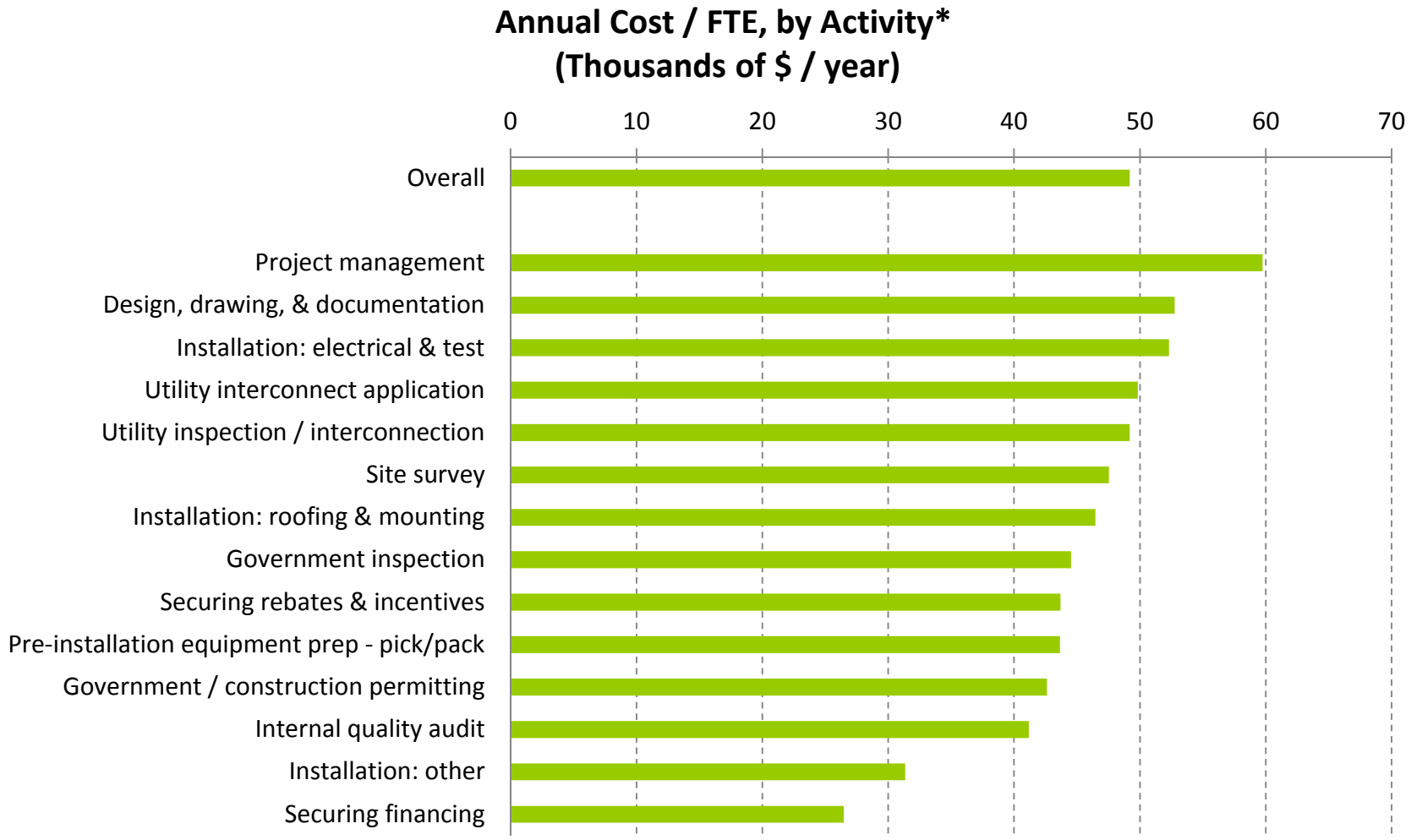
Generally, when firms subcontract more they should require less internal labor



- **We would expect firms that subcontract more to require less internal labor; broadly, this is what we see**
- **However it would appear dealers G, J, and H in particular should:**
  - Review if they can get more productivity from internal staff given the relatively high amount of outsourcing
  - Review whether the rates they pay to subcontractors are competitive

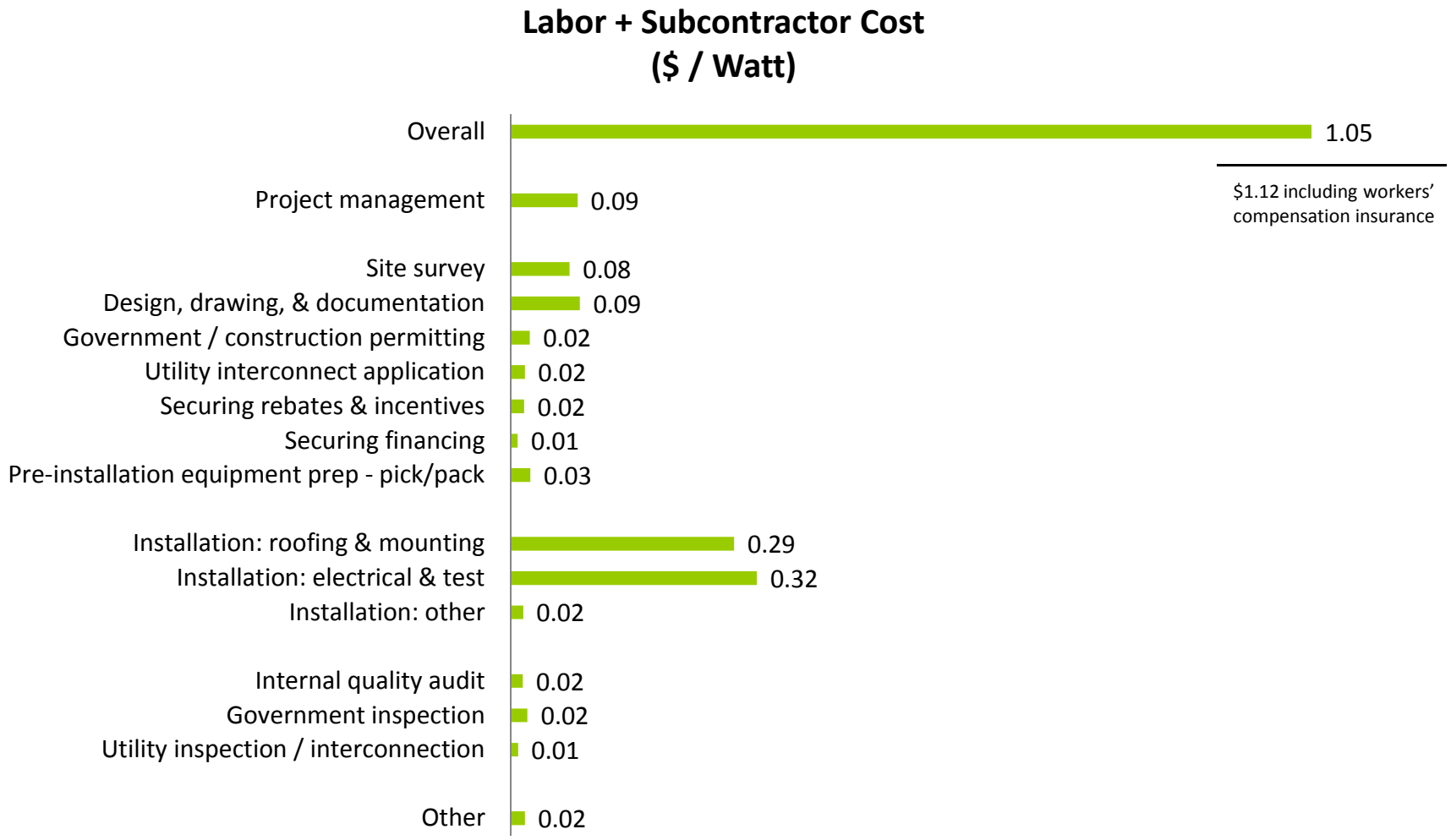
Notes: Mean not included in regression data.

Cost per installation employee averaged $49,000 / year



Notes: * Includes salaries, wages, variable compensation, employment taxes, and benefits. Excludes workers' comp. insurance.

Roofing and electrical installation were the most significant installation labor costs



Notes: Includes salaries, wages, variable compensation, employment taxes, benefits, and subcontractor fees. Excludes workers' comp. insurance.

Many dealers have experimented with on-site team size and composition; most use four man teams

- **One dealer uses two or three people on its teams**
  - "Sometimes the job is a three-person job, sometimes two-person. Sometimes two people work on that job the whole time and the project manager will spend a portion of the time out there."
    Dealer G
- **The dealer with the lowest labor cost in our study uses three-man teams**
  - "Typically it is a three man crew. One electrician, a roofer, and a laborer."
    Dealer A
- **The most commonly dealers put four people on a site**
  - "We are now at four—three mechanical, one electrical. We have tried different combinations to see if we could build them faster with more staff but we didn't find that to be the case. We even tried six or eight per team. We have used three-man teams on occasion. Right now for us the four-man team works best."
    Dealer D
  - "Typically [it's a] four-man team. We will put two guys on the roof, one guy in the attic, and the lead will do other stuff in the garage."
    Dealer C
  - "Generally, we have a have roofing truck and electrical truck…Two [people] in each."
    Dealer L
  - "We think a crew of three is most efficient for the…roof work. We think four is inefficient and two is as well. We've tried five of all things. We spent a lot more money on those installations. There is just not enough space on the roof and not enough to do for everyone to be busy. Even with three people there are usually only two on the roof. We generally use also use one electrician."
    Dealer J
- **A few use even more, though other dealers find this isn't efficient**
  - "We have four to five guys per job…I have my electrician and a helper there with the other guys."
    Dealer I
  - "We have three men that do the roof…Then we have an electrician and an electrician's helper. However, it is typically not more than three at once. Typically the roof crew gets everything done and then the electricians come on site."
    Dealer K

Dealers can use a number of strategies to reduce labor costs (1 of 2)

- **Know where you stand on spectrum of labor productivity and cost, strive to improve**
- **Use standardized systems designs**
  - "I'm trying to take the word 'engineering' out of residential. Not engineering and construction – configuration and assembly. Fundamentally I'd like to get to a 15 minute learning curve for how to design."
    Dealer E
  - "We sell 14 system sizes / configurations. Our smallest is 2.5kW with 10 panels. We never sell 11 or 12. Our next step up is 14 panels."
    Dealer D
- **Focus on city/regional market share (though consider the benefits of diversifying across incentive areas)**
  - Requires coordination with sales and marketing
  - "With the Solarize programs you really start getting into a rhythm. There is consistency in where you are working – dealing with one jurisdiction."
    Dealer H
  - "We group our installations together [geographically] to reduce drive time."
    Dealer F
- **Have sales do the site survey**
  - Easier if there are a small number of standard systems they are selling. Do not measure to create a custom design. Measure to determine "Which one of options A, B, or C would fit on this house?"
  - Admittedly, sales must be trained in the correct issues or this creates a lot of headaches later
- **Centralize where possible**
  - "We typically don't do design at the local level because it doesn't create the highest utilization and spreads out the skill sets. Also, if you centralize, you can use some drafters in the mix rather than all more skilled labor. "
    Dealer E

Dealers can use a number of strategies to reduce labor costs (2 of 2)

- **Use four 10-hour days, especially when travel times are significant**
  - Reduces time for travel (and vehicle expenses)
  - Gives flexible schedule options to accommodate weather
  - "We've gone from five 8 hour days hours days to four 10 hour days. The four 10 hour days buys us an extra hour and a half in travel time that we don't have to pay for. Also, if it rains on Wednesday we can just have them work on Friday. We also save wear and tear on trucks and gas. Plus if I get in a jam I can work them on Friday and they still have a weekend."
    Dealer C

- **Use cellular transmission for monitoring data**
  - "We spend a lot of time working on internet issues."
    Dealer B
  - "We spend quite a bit of time on monitoring and troubleshooting monitoring it. Sometimes it is the internet, sometimes login, the unit itself, configuration. It seems like we are always on the phone for a couple of hours with [our vendor] about something."
    Dealer G
  - "We don't use the home network because it adds to the installation time and causes maintenance problems because every time the teenager plays with the router we have a service call…We use cellular cards…and [pay] less than $2 / month for the cellular connection."
    Dealer D

- **Make sure installation teams know why previous installations in a jurisdiction failed inspections**

- **Schedule inspection for last day on-site**
  - "Most municipalities you call the day before you want the inspection. We generally try to request an afternoon inspection, but it is hit or miss when they show up. Most inspectors have office hours in the morning, so we try to call to see exactly when they will be there. If we are falling into the morning inspection window, we tell him we will not be ready. We'll ask to move to 12 or 1 p.m. If he does show up, at least he'll know so he won't be angry. Some we have built a rapport with so they will sign off on the basis of what we have done."
    Dealer A

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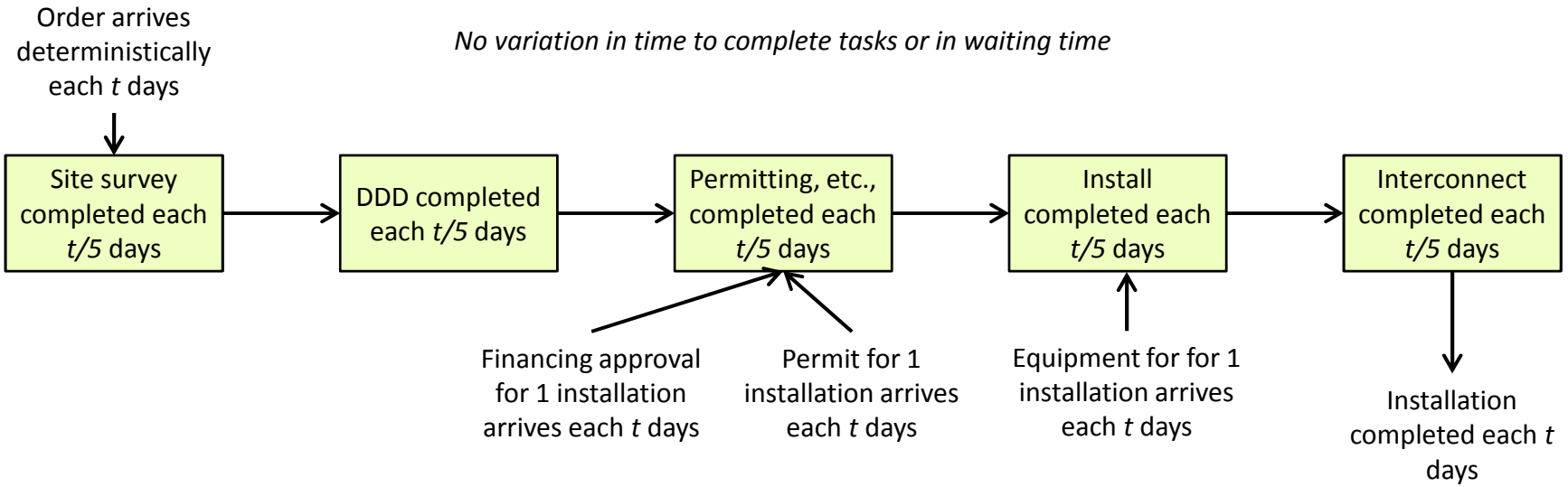
The ideal process would optimize throughput, inventory, and expense by minimizing variability

A Perfect (Though Highly Idealized) Solar Installation Process

No variation in time to complete tasks or in waiting time



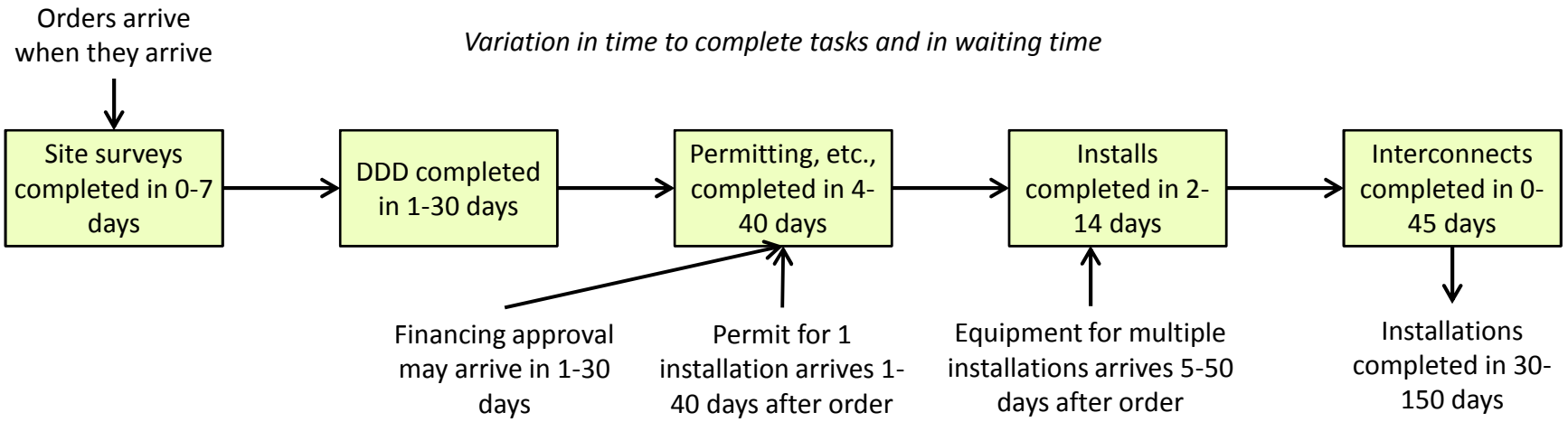
Key Process Characteristics	Results
Order-to-interconnect time is predictable and short. Dealers only manage a few in-process installs at once.	Few customers cancel orders & Expenses minimized
No workers are ever waiting for work. Each production step operates at 100% utilization.	Labor expense is minimized & Throughput is maximized
No need to keep safety stock of inventory to make sure there is something to work on.	Inventory is minimized

Notes: The optimal process also requires no fixed order delivery cost.

In the real world, variation makes timelines longer and/or increases costs

A More Realistic (Though Simplified) Solar Installation Process

Variation in time to complete tasks and in waiting time



Key Process Characteristics	Results
Order-to-interconnect time is unpredictable and long. Dealers must manage many in-process installs at once.	Customers cancel orders & Expenses increase
Each step requires "extra" capacity so it is possible to make up for delays caused by previous steps. Utilization is < 100%.	Labor expense increases & Throughput decreases
Dealers keep safety stock of raw materials (such as panels or permits) to ensure enough is on-hand to keep working.	Inventory increases

The solar installation business has multiple sources of timeline uncertainty (1 of 2)

- **The sales process is a source of variability in both what dealers are selling (custom systems) and when orders arrive**
  - "A problem is that if our capacity is three per week, but we don't sell exactly three per week. We might sell none one week, then four, five, or six the next week."
    Dealer B

- **Permitting in particular is a major source of uncertainty**
  - "Installation time over the last year varied from 16 to 112 calendar days! The things that make it variable are distance, weather, and permitting. We have [City A] eating out of our hands and get that in two days, but [City B] takes 2 weeks or more."
    Dealer G
  - "The city of [City C] is very cooperative. You get a one day permit—it's a walk in. All the other communities it is three to ten days—that's inefficient."
    Dealer J
  - "I keep coming back to [City D]. We've had permits take over two months and had to threaten legal action. They've sent them back saying 'fix this,' and then when we send them back and they come back and say "now you need to fix these *other* things", and so on. And they have ten business days to review each time, so since they only work four days per week that is like 3 weeks! We are hiring someone that all they are going to do is call customers and explain what is going on with longer-than-expected timelines."
    Dealer I

- **Finance companies also drive timeline uncertainty**
  - "It is not just that [finance companies] have a lot of time and milestones, but that it is highly variable, and that kills us from an operations side. I have two employees who came from other installers because they went out of business because all their projects were stuck in the financing process."
    Dealer B
  - "Sometimes it is third party approvals – you have to bug them all the time. They change their people all the time. We send them four documents in four separate emails at four different times. There are probably eight or nine communications. Every time is an opportunity for someone to not get the email, misfile, etc."
    Dealer H

The solar installation business has multiple sources of variability (2 of 2)

- **Of course, hardware vendors can also be a source of uncertainty**
  - "The shipment delays cause a lot of rescheduling. We used to be able to order and get the equipment on the requested date. We have now started pooling [inventory] in the warehouse so we can keep the installation."
    Dealer A
  - "Last January and February I literally had guys at home I was paying with nothing to do because I could not get modules."
    Dealer G
- **Monitoring seems to be causing a lot of variation in installation time**
  - "Setting up the monitoring and internet and stuff like that can jam you up."
    Dealer G
  - "The monitoring products …all have a weakness in that they rely on a wireless or power line connection to the home networks and we find our selves troubleshooting them 25% of the time."
    Dealer J
- **It's also hard to predict when inspectors will arrive**
- **Dealers will never be able to entirely control some sources of variation**
  - Customers changing requested installation dates, weather, variation in worker speed, etc.
- **Uncertainty causes follow-on costs and requires more complex systems than would otherwise be necessary**
  - "The cost issue is not about doing a certain piece better, it is about changes to the process…Variability requires more resources to manage…"
    Dealer B

To minimize variability and minimize costs, dealers should:

- **Synchronize sales promotions and capacity**
  - Also focus on certain cities or regions instead of aiming for broad geographic coverage
- **Emphasize to hardware suppliers the importance of delivery on promised dates**
  - Penalties for missing delivery promises
  - Switch vendors if necessary
- **Work with finance vendors to minimize variability and favor those that follow through**
- **Support industry efforts to standardize and simplify local permitting process**
- **Standardize systems to minimize variation in design, pick/pack, and installation time**
  - Sell one of *x* standard systems (i.e. 3, 5, or 7 kW)
- **Cross train workers so if they are out of work on their specialty activity they can work on another part of the process**
  - i.e. site surveyor who doesn't have anything to survey can do system design
  - This does not reduce variability but it reduces cost of dealing with it

Vendors: To win loyalty and pricing power, focus on predictability.

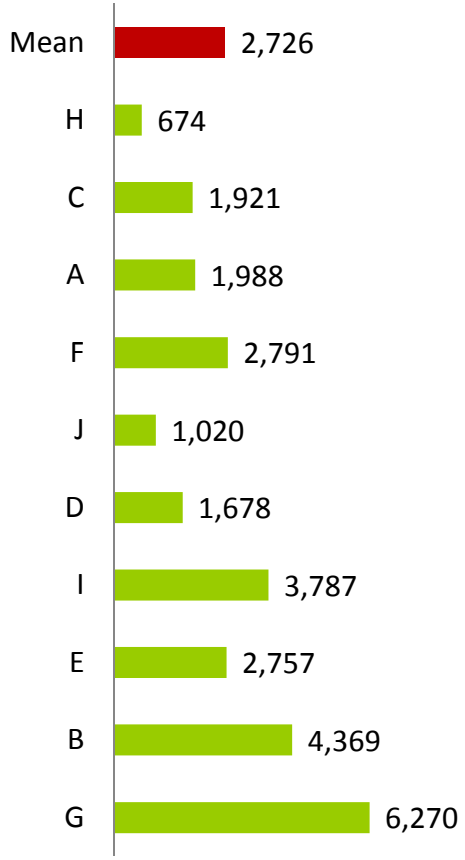
Contents

Cost of balance of system hardware varies significantly by dealer

BOS Hardware Cost ($ / Watt)

- **BOS costs varied greatly among dealers, suggesting a significant opportunity for cost advantage for dealers that focus here**
- **System standardization would also help reduce BOS costs**
  - Higher volume of smaller number of SKUs reduces both cost and inventory
  - Standard BOS could be stocked on trucks, minimizing trips to local hardware stores or supply houses for small-lot purchases

BOS Hardware Cost ($ / System)



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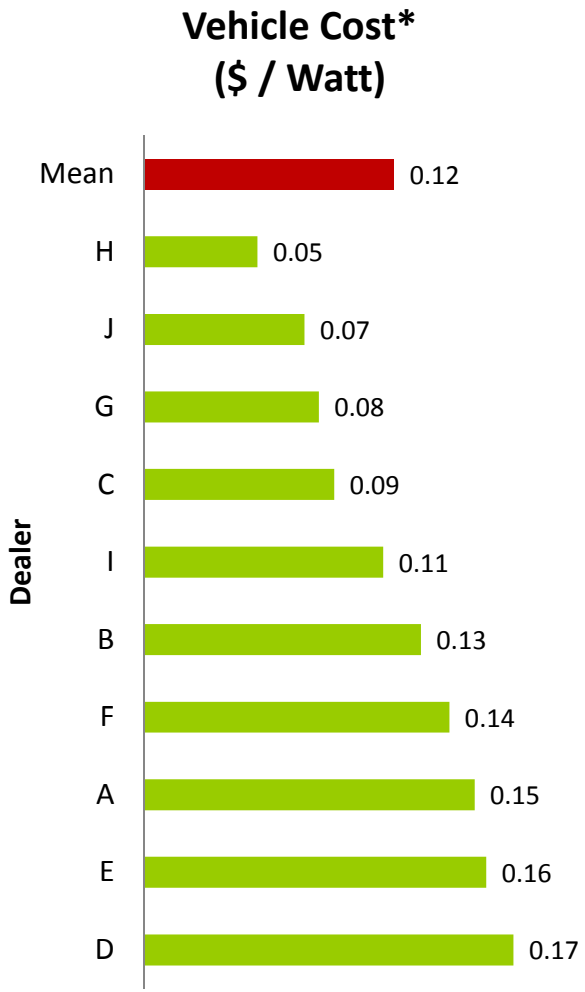
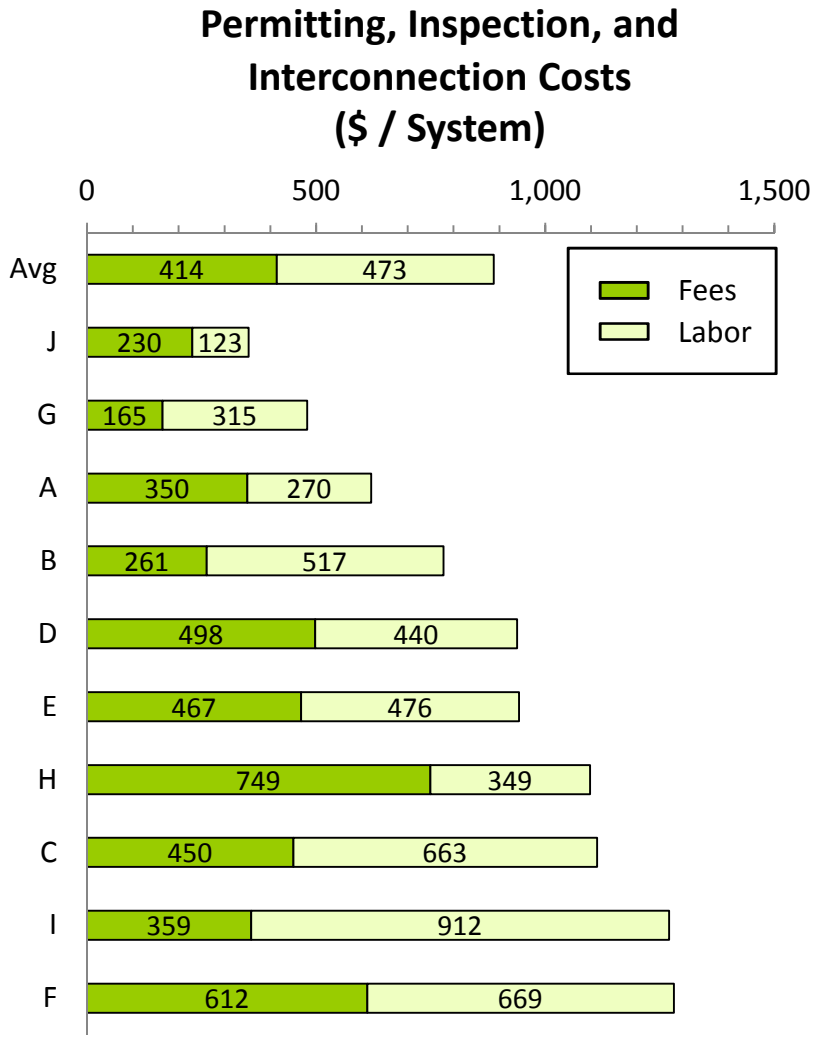
To reduce vehicle expense, reduce number and length of trips



- **Many techniques to reduce labor will also reduce vehicle expense**
  - Have sales do site surveys (Dealer H does this)
  - Work four 10-hour days (Dealers J, C, and I do this)
  - Standardize system designs or truck inventory to reduce trips to hardware stores
  - Focus on city/regional share to reduce distance and get more efficient with permitting jurisdictions
  - Schedule inspections for last day on-site
  - Make sure installation teams know why previous installations in a jurisdiction failed inspections
- **In addition, match vehicle seats to optimal team size**
  - I.e. if optimal team size is three, acquire vehicles with three seats to avoid sending two trucks

Notes: * Includes lease payments, depreciation, fuel, maintenance, and payments to employees for the use of their own vehicles.

Costs permitting, inspection, and interconnection costs average at least $888 / system

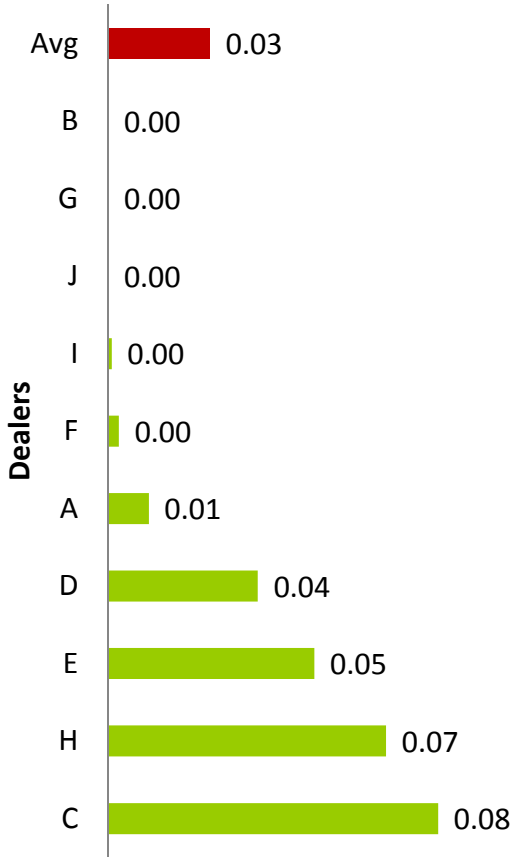


- **Equivalent to $0.15 / Watt**
- **Includes fees for construction permits and interconnect application**
  - Vast majority is fees for construction permits
- **Includes labor to make permit and interconnect applications, meet inspectors, and meet utility personnel (when necessary)**
- **In early 2011 SunRun estimated the costs of local permitting and inspection to be $2516 / system, but their figures include many costs Woodlawn Associates captured elsewhere:**
  - $581 for system costs incurred because local codes exceed state or national standards. (These costs would be in our material or installation labor costs.)
  - $520 for sales and marketing costs. (Sales and marketing costs are excluded from this study, though we have previously calculated that the cost of customer acquisition in solar is $5373 / system.)
  - SunRun's figures may include additional costs what we capture elsewhere (such as the costs of vehicles used to deliver applications, pick up permits, or meet inspectors)

Source: Woodlawn Associates, SunRun (The Impact of Local Permitting on the Cost of Solar Power)

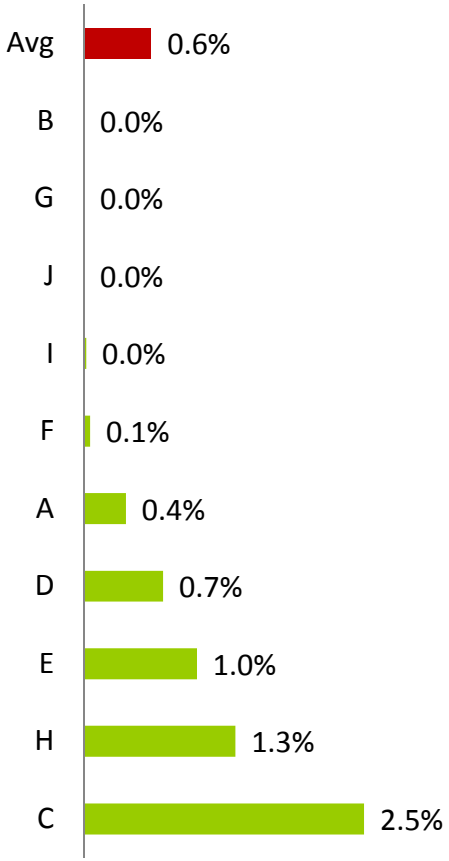
The average warranty expense was $0.03 / Watt or 0.5% of revenue; we suggest a $0.05 or 1% reserve

Warranty Expense ($ / Watt)



- **Dealers handled warranty expenses in one of four ways:**
  - A reserve in COGS
  - Actual warranty expenses in COGS
  - Actual warranty expense in opex (not in gross margin)
  - No record of warranty expense
- **Most mature businesses include a reserve to cover future warranty expenses in COGS**
  - Seems this would be especially prudent when systems are supposed to last 20 years or more
- **Dealers D and E had the most robust explanations for their warranty reserve**
- **We would suggest other dealers use a comparable figure unless they have a reason to do otherwise**

Warranty Expense (% of Revenue)



Third party finance has opened up the market but is not without costs

- **Many dealers complain about the time for and unpredictability of various requirements of third party finance companies**
  - "The workload for a lease deal in terms of the time we spend on paperwork is triple that for a cash deal."
    Dealer I
  - "A lease always adds about 4-8 days to the front of the process…There is still some red tape… it is really mostly formality, but the leasing company wants to capture a proper signature….That gets transmitted to the leasing company...Simple things hang it up. If the electric bill is 'Jonathan' but the customer agreement is 'John' we have to go re-sign the agreement."
    Dealer J
  - "They are like another jurisdiction in that they review design work."
    Dealer M
- **This suggests that dealers with internal finance capabilities may be at a cost advantage**
  - No extra step of having a design reviewed by a third party
  - Information entered into only one computer system
- **However, third party finance companies can close this gap and distinguish themselves from one another**
  - Audit a partner's design process. If they meet requirements, don't require engineering review of each system (perhaps require occasional post mortem audits)
  - Eliminate rejections caused by "unnecessary" or "paranoid" checks (see comment from Dealer J, above)
  - Modify process to catch errors earlier, when costs to fix them are lower
- **Finally, since large dealers buy modules and inverters for about $0.36 less per Watt than small dealers, finance companies should consider using their scale to extract savings here**
  - Could be done by taking inventory and delivering kits, but also by negotiating rebates from key equipment vendors (contact us for details)

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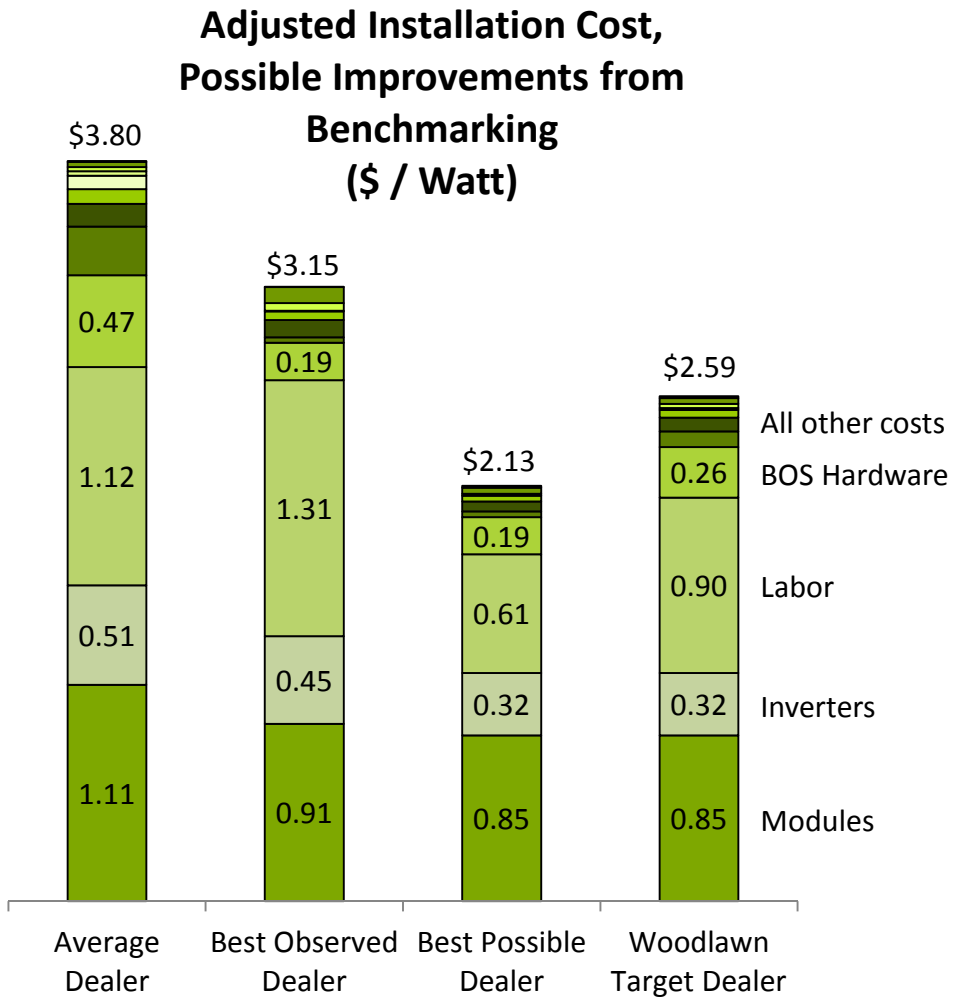
By matching low cost dealers in each category, dealers could install for $2.13 to $2.59 / Watt



- **The average adjusted installation cost* in our study was $3.80 / Watt, while the dealer with the lowest observed cost was $3.15 / Watt**
- **If a single dealer could achieve the lowest cost we observed *in each cost category*, it could install at $2.13 / Watt**
- **We also built up costs for a "Target Dealer", who could install for $2.59 / Watt**
  - There may be circumstances unique to certain dealers that allow then to achieve very low cost in a single category, but not across categories
- **Key assumptions for Target Dealer:**
  - Modules and inverters have relatively transparent global prices so we assume the cost of our best dealer in each category
  - No sales tax paid on dealer purchases
  - Warranty reserve of $0.03 / Watt
  - Cost of second-lowest cost dealer in our study in most other categories

Notes: * Installation cost assuming the dealer purchases all hardware.

Summary of dealer recommendations

1. Build and maintain cost tracking system and match/meet provided benchmarks in each of the areas below
2. Make sure systems sold are large enough
3. Minimize process variation

Modules

4. Minimize inventory (avoid write-downs)

Inverters

5. Confirm micros are worth premium for production, monitoring, or sales value

BOS Hardware

6. Standardize and simplify

Labor

7. If subcontract, make sure rate is competitive with employees
8. Standardize systems
9. Have Sales do site survey
10. Focus on regional market share
11. Centralize where possible
12. Use four 10-hour days
13. Use cellular radios for transmitting monitoring data
14. Learn from inspection failures
15. Meet inspectors last day on site

Other Costs

16. Improve labor productivity to improve vehicle expense as well
17. Match vehicle size to team size
18. Favor city/regional growth over geographical growth to reduce vehicle use
19. Use a warranty reserve; 1% is recommended

Installation Overhead

Woodlawn Associates would be delighted to help you implement any of these recommendations