

Workshop 1:

Key technical considerations for installations of commercial solar

Commercial Acceleration of Solar Energy
in Silicon Valley (CASE-SV)

Moderator: Eileen Hays, Optony

August 13, 2014

2:00-3:00PM PT



Joint Venture
SILICON VALLEY



OPTONY

Agenda

Welcome and CASE-SV Overview (5 min)

Ben Foster, Senior Vice-President for Optony

Don Bray, SEEDZ Executive Director for Joint Venture

Case Study: Kaiser Permanente's 50MW+ solar project (20 min)

Featured Speaker: Ramé Hemstreet, Chief Energy Officer for Kaiser Permanente

Commercial Solar Technical Considerations Presentation (20 min)

Technical Expert: Jonathan Whelan, Senior Project Manager for Optony

Q&A (15 min)

Program Sponsors

American Solar Transformation Initiative

Goal to reduce the total installed costs of solar PV and increase deployment across the US by partnering with 200+ local governments, utilities, and regional organizations to improve their solar markets.

- Created and led by **Optony**, funded by the US DOE
- More information at www.SolarRoadmap.com/case-sv



Smart Energy Enterprise Development Zone (SEEDZ) Initiative

Unites key stakeholders in building the smart energy network of the future: reliable, high quality, affordable, and sustainable power.

- Created and led by **Joint Venture Silicon Valley**
- More information at www.JointVenture.org/seedz



Commercial Acceleration of Solar Energy (CASE-SV) Initiative

Support accelerated deployment of solar PV energy for commercial facilities in Silicon Valley with an aggregated purchasing program.



Target: Advance solar energy by at least 5 MW, and/or 10 commercial sites in Silicon Valley by Q3 2015

Key stakeholders: Business leaders, Municipalities, and Regional organizations.

Solar purchase options

- Onsite Systems
 - Direct purchase
 - Power purchase agreements
- Offsite Options
 - Remote solar projects
 - Regionally-sourced solar renewable energy credits

What is the rationale for a CASE-SV program?

Why are businesses and property owners participating?

- Offset high energy consumption and escalating costs
- Achieve clean energy commitments
- Demonstrate community leadership
- Leverage CASE-SV team, resources and regional solution providers

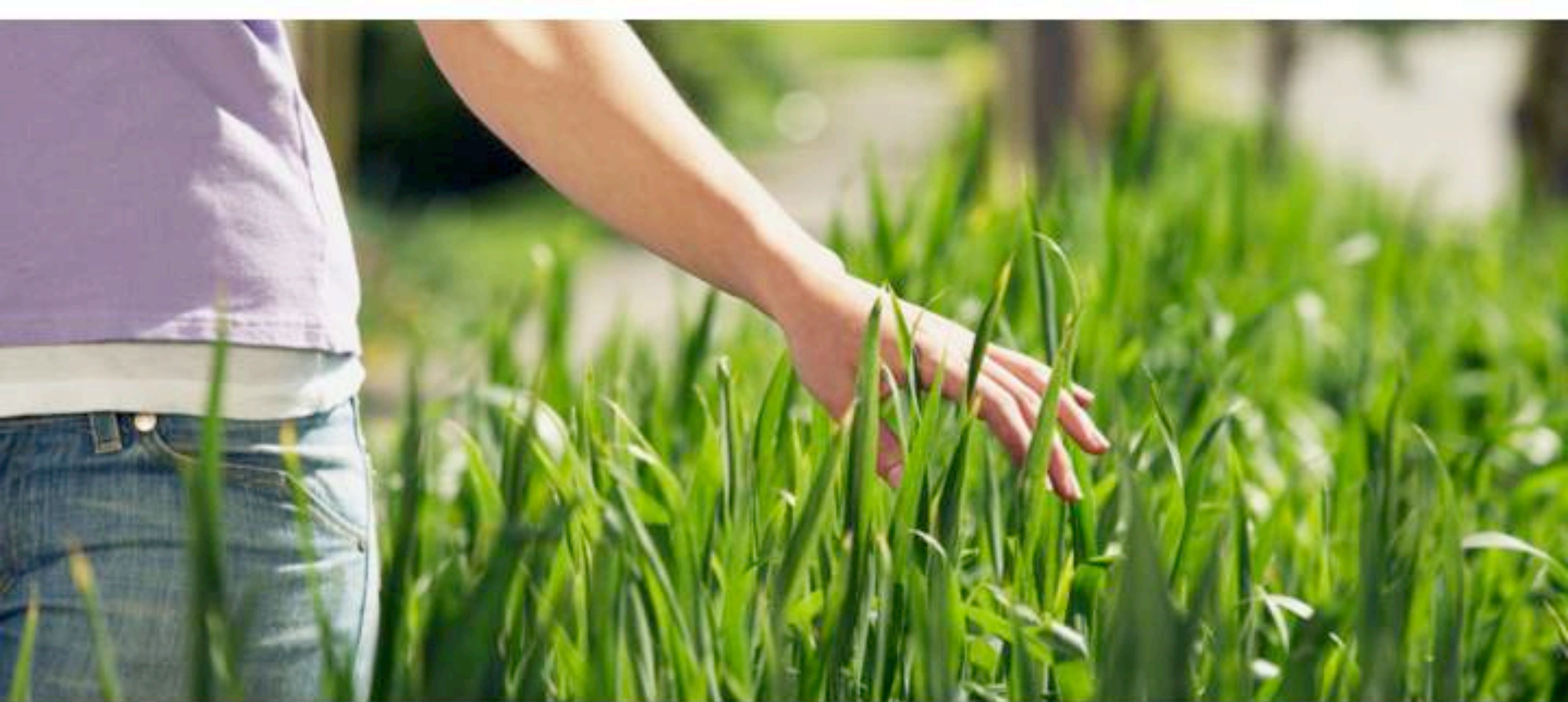
Why now?

- Federal 30% Investment Tax Credit to sunset Q4 2016
- State Net Metering rules and rates will change in 2017
- Average PV installation costs are at an all time low
- Recognition programs from EPA and JVS



Featured Speaker

Ramé Hemstreet, Chief Energy Officer
Kaiser Permanente



Kaiser Permanente On-site Renewable Energy Program

August 13, 2014

KP National Sustainable Energy Policy

- Reduce GHG emissions by 30 percent by 2020 (from 2008 levels)
 - Increase renewable sources
 - Decrease energy demand
 - Better manage energy costs
 - Publicly report GHG emissions

KAISER PERMANENTE. Share Our Views, News and Moves

Thinking Healthy | Spreading Ideas | Taking Action | Making Headlines

Spreading Ideas

Press Release

Kaiser Permanente Pledges to Reduce its Carbon Footprint by 30 percent by 2020

Organization works to reduce impact on climate to improve health

February 28, 2012


TOPICS: ENVIRONMENTAL STEWARDSHIP, OPERATIONAL EXCELLENCE | REGIONS: NATIONAL

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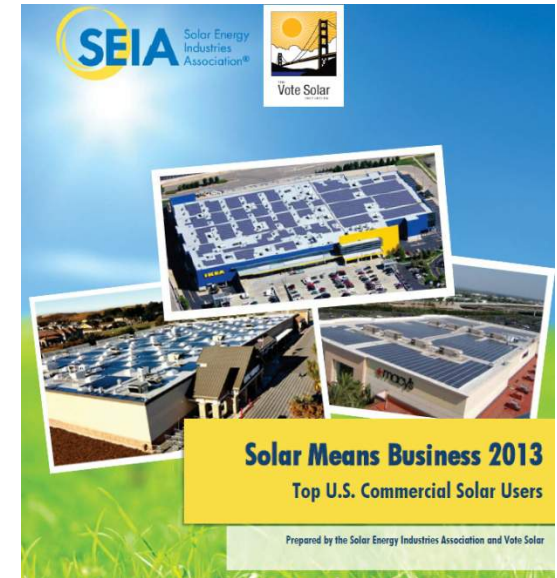
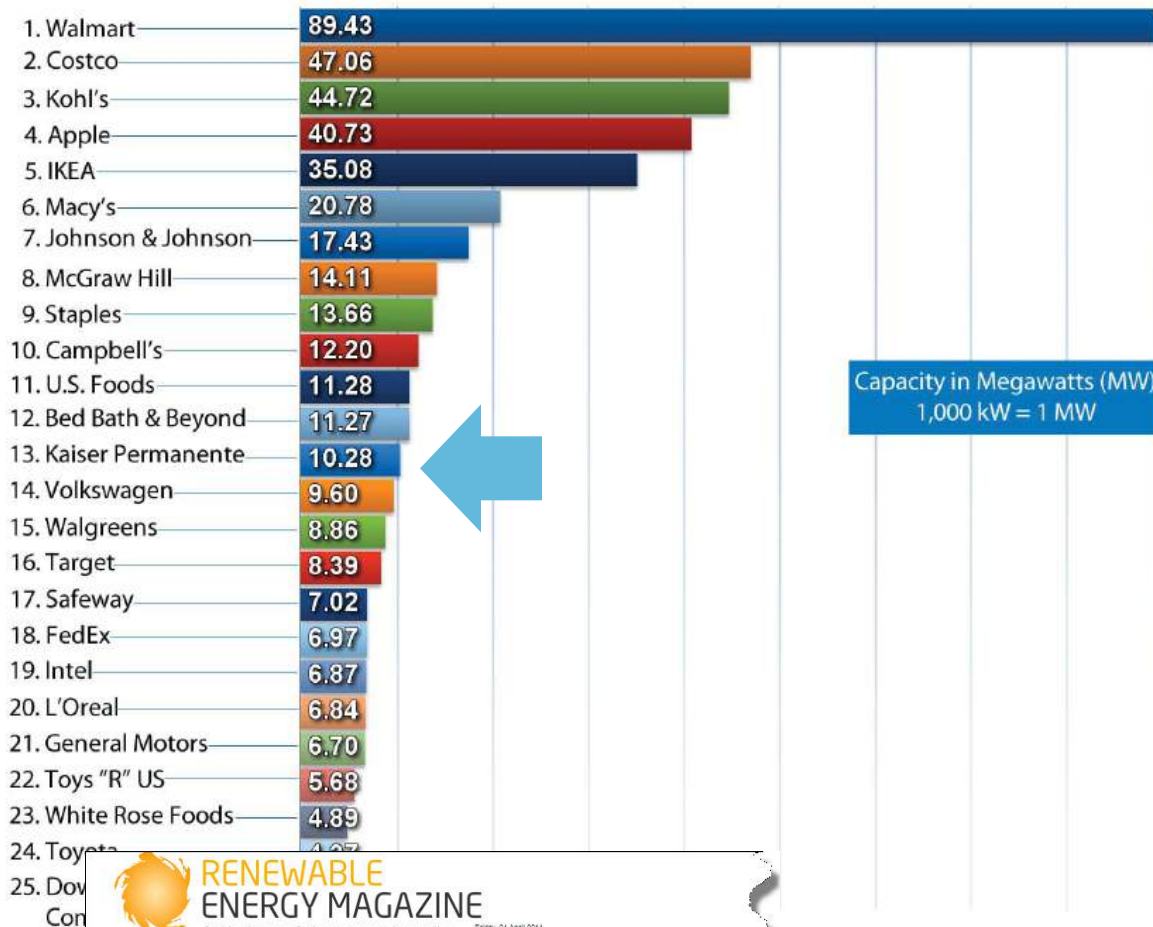
OAKLAND, Calif. — As part of its ongoing commitment to improve the health of the communities it serves, Kaiser Permanente announced today that it is rolling out an aggressive strategy to reduce its overall greenhouse gas emissions by 30 percent by 2020 compared to its 2008 levels. The strategy includes plans to invest in clean and renewable energy sources while also targeting energy conservation measures.

By reducing its reliance on fossil fuels and trimming overall energy consumption, Kaiser Permanente expects to minimize its greenhouse gas emissions, which are known contributors to climate change and the rise of pollution and disease.

"Kaiser Permanente is committed to creating healthy communities, and the action we've taken today is a key step in that effort."



Renewable Energy Leader: Onsite Generation



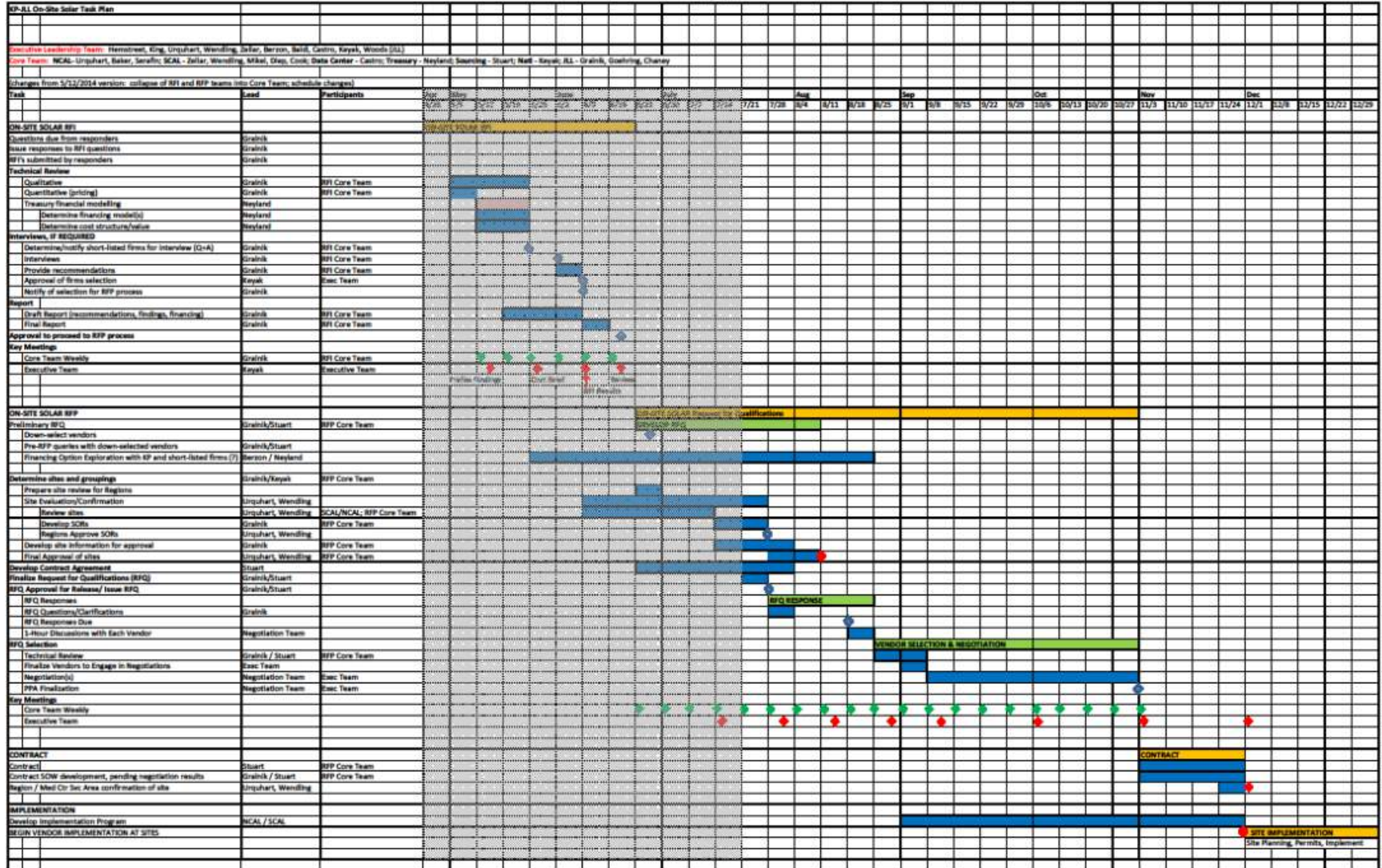
Green Power Leadership Award from the U.S. Environmental Protection Agency in 2013

On-Site Solar Program Development

- Original concept was based on individual sites with capacity of +200 kW
- Comparison of “Series of Projects” approach to “Portfolio Program” approach results in:
 - Portfolio Program levels out energy cost differential across multiple sites thereby allowing for greater opportunity to reduce KP costs at broad scale, and to introduce solar energy to more sites
 - Internal support at executive level required due to KP internal site “ownership” structure
 - Larger sites are currently more cost effective on \$/kWh; “Big bang” will come from smaller sites and greater potential for energy cost differences
 - Sites now included in program have minimum threshold of 100 kWh
- Solar supplier selection (in process)
 - 28 suppliers solicited; 19 responded; current short list of 7
 - Interviews and BAFOs will result in PPA discussions with 1-3

On-site Solar PPA Schedule

TASK PLAN
ON-SITE SOLAR PROGRAM VENDOR SELECTION PROCESS
July 18, 2014



Criteria for Success

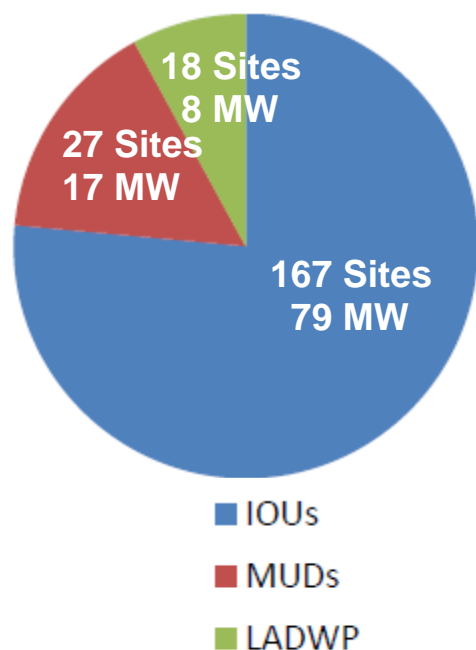
- **“Do no harm”**: The portfolios of sites must “meet or beat” today’s aggregated energy costs at commissioning, AND
 - No individual site within a portfolio can exceed the maximum \$/kWh threshold determined
 - 14 portfolios of sites in California
- Each site is confirmed for 20-year viability of PPA lease to solar supplier
- Fees and costs (consultant fees, installation costs and implementation impacts) are paid by solar supplier
- Municipal Utility District sites to be managed separately (some require modified PPA or agreement structure), but also use portfolio program structure

Site Screening Criteria – over 400 sites

- **Screen 1: Usage Sizing, removed from list included:**
 - All non-CA, leased and existing solar sites
 - Sites serviced by Municipal Utilities (reserved for further evaluation)
 - Sites paying \$0.105 or less per kWh
 - Sites with less than 100kW system potential (based on 70% of total kWh usage)
- **Screen 2: Physical Sizing**
 - Removed sites that Client might vacate within 20 years
 - Obtained parking space counts for remaining sites (bulk of arrays will be over parking)
 - Multiplied space counts by 2.2 kW to calculate site's max physical potential
- **Compared Usage Sizing to Physical Sizing, using minimum value as site's potential**
 - Screening resulted in 167 sites (not including MUDs)
 - Potential project size = 79 MW (conservative)
 - Total potential including MUDs is 212 sites and 104 MW (conservative)

On-Site Solar Portfolio Potential

On-Site Portfolio Potential



			Breakout by size			
Utility	MW	Total Sites	over 1 MW	500 - 999 kW	200 - 499 kW	100 - 199 kW
NCAL						
IOUs	47	103	9	14	56	24
Munis	7	14	1	1	10	2
NCAL Total	54	117	10	15	66	26
Data Centers						
Data Centers	1	2	0	1	1	0
Data Center Total	1	2	0	1	1	0
SCAL						
IOU	31	62	5	16	31	10
Munis	10	13	2	4	5	2
LADWP	8	18	1	3	9	5
SCAL Total	49	93	8	23	45	17
Portfolio Total	104	212	18	39	112	43

Initial Results from RFI (+200kW site screening)

PPA Pricing (per kWh installed)

	Ground mounted carports 3%	Parking structure rooftop carports or canopies 3%	Ballasted rooftop arrays 3%	Ground mounted fixed rack array 3%	Production kWh/kWp
Northern CA	\$0.093 - \$0.127	\$0.100 - \$1.46	\$0.074 - 0.107	\$0.070 - \$0.094	1,517 - 1,632
Southern CA	\$0.081 - \$0.115	\$0.095 - \$0.142	\$0.066 - \$0.93	\$0.070 - \$0.090	1,573 - 1,828

EPC and O&M Turnkey Pricing (per kWh installed)

	EPC Turnkey Option Price (\$ per kWh installed)				O&M Turnkey Option Price (year 1 \$ per MW)				Production
	Ground mounted carports	Parking structure rooftop carports or canopies	Ballasted rooftop arrays	Ground mounted fixed rack array	Ground mounted carports	Parking structure rooftop carports or canopies	Ballasted rooftop arrays	Ground mounted fixed rack array	kWh/kWp
Northern CA	\$2.55 - \$3.15	\$2.64 - \$3.70	\$1.86 - \$2.74	\$1.82 - \$2.72	\$10,980 - \$16,650	\$10,980 - \$16,650	\$10,980 - \$16,650	\$10,980 - \$16,665	1,499 - 1,625
Southern CA	\$2.52 - \$3.36	\$2.60 - \$3.70	\$1.85 - \$2.63	\$1.82 - \$2.65	\$10,613 - \$18,464	\$10,613 - \$18,464	\$10,247 - \$18,464	\$11,280 - \$18,464	1,573 - 1,783

Notes:

1. Unit price ranges for 9 of the lowest solar vendors responses (18 respondents total).
2. Rate includes 3% escalation factor after first year.
3. OSHPD-related unit prices not included.



Technical Expert

Jonathan Whelan, Senior Project Manager
Optony, Inc.



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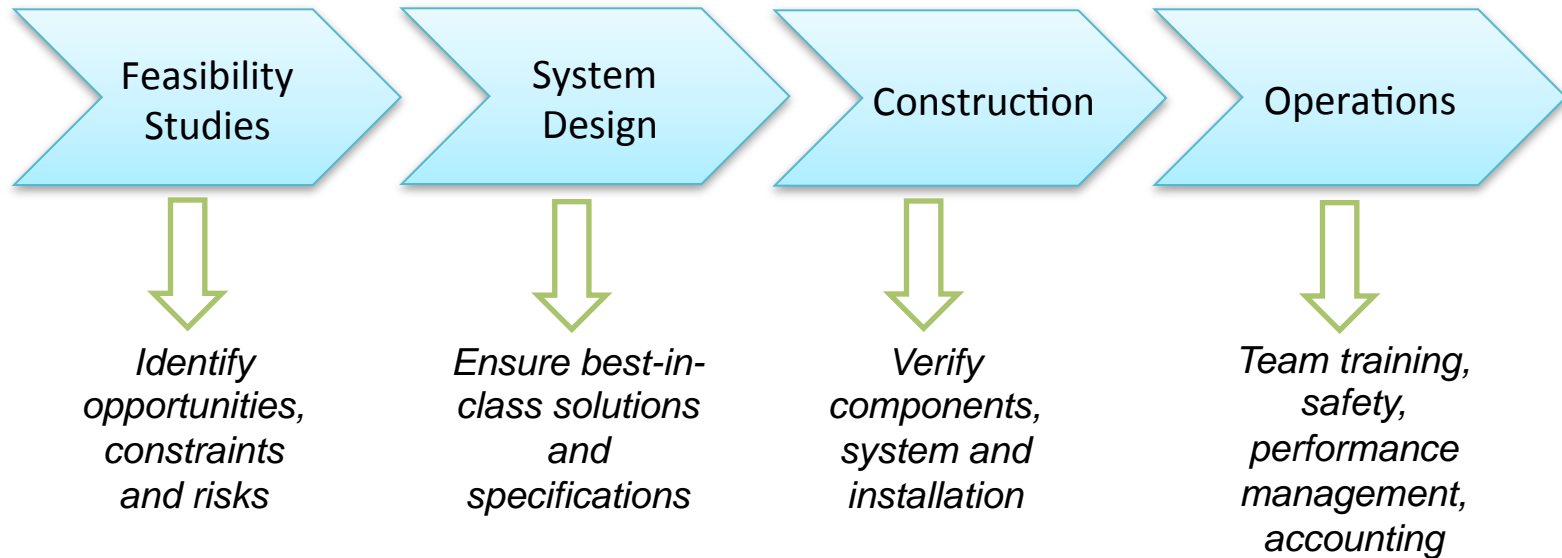
Solar Project Installation and Technical Considerations

August 2014

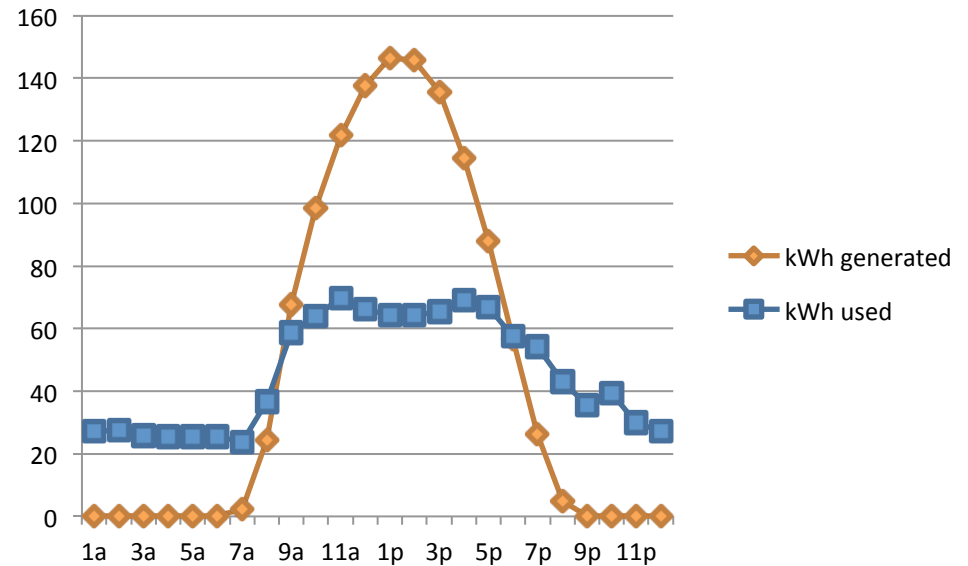
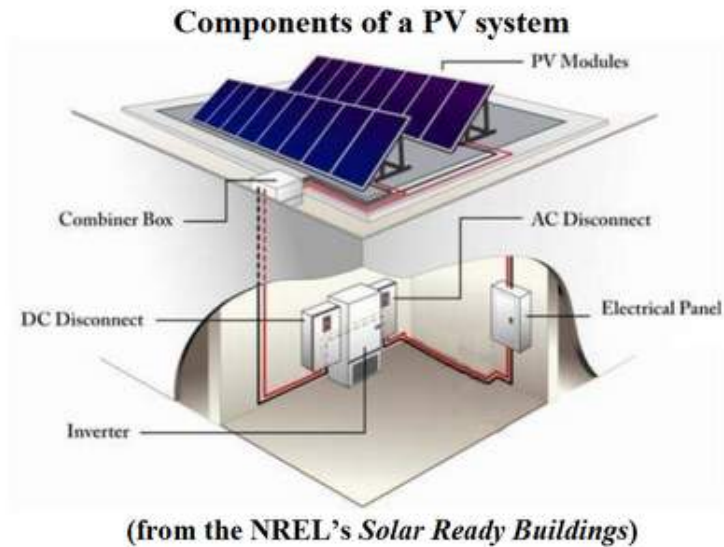
Agenda

- Planning and Managing On-Site Solar
- How Solar Works
- Overview of Technology and Installation Types
- Feasibility Assessments and Design Considerations
- Project Management and Commissioning
- Operations and Maintenance
- Next Steps

Solar Project Technical Planning & Management



How Solar Works: Grid-Tied System



Total energy generated: 1,171.86 kWh

Total energy used: 1,092.61 kWh

Overview: Solar Energy Technology Examples

Solar Photovoltaic (PV) Panels/Modules



Solar Hot Water



Utility Scale Concentrated Solar Farm



Review of Installation Types

- Rooftop
 - Penetrating
 - Ballasted
 - Standing-Seam
 - Laminate
- Carport/Shade Structure
 - Fixed-tilt
 - Tracking
- Ground-mount
 - Fixed-tilt
 - Tracking
- Floating
- Building-Integrated PV (BIPV)

Installation Examples

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Example: Flush Mount Installation



Installation Examples

- **Rooftop**

- Penetrating
- **Ballasted**
- Standing-Seam
- Laminate



- **Carport/Shade Structure**

- Fixed-tilt
- Tracking



- **Ground-mount**

- Fixed-tilt
- Tracking



- **Floating**

- **Building-Integrated PV (BIPV)**



Example: Low-Tilt, Ballasted Racking System



Example: High-Tilt, Ballasted Racking System



Installation Examples

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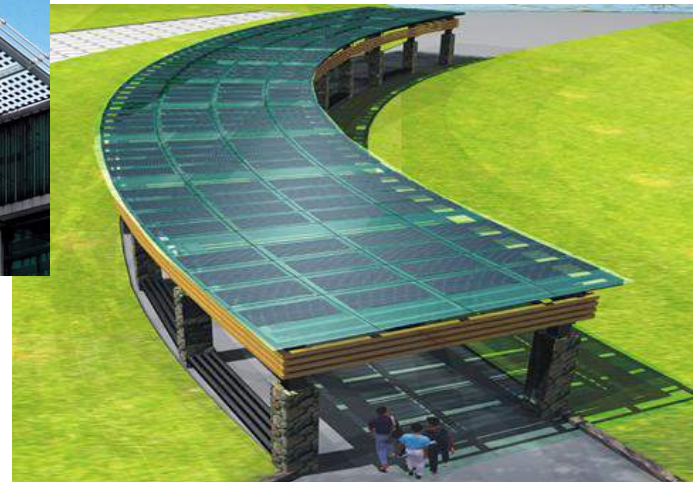
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Solar Site Feasibility Checklist

- Portfolio approach to site evaluation
- On-site survey
- Structural & Electrical evaluation
- Construction concerns and design considerations
- Utility rate evaluation
- Review of funding and incentive options
- 20 year LCOE Financial analysis
- Benchmark comparison of pricing & trends
- Technical risk assessment
- World-class tools & methods



Design Considerations: Rooftop

Considerations:

- Building structural capacity
- Site-use planning
- Parcel ownership
- Building orientation
- Shading from trees, buildings, power lines
- Accessibility
- Roof type
- Rafter spacing and type
- HVAC or other rooftop obstacles
- Location of interconnection points
- Damage or theft hazards

Opportunities and Constraints:

Weight loading; wind loading; seismic

Move or stop operations; re-purpose

Usable? Able to interconnect?

South-facing = good; north = not so good

Shade kills solar production

Expense of construction; operational impact

Penetrations or ballasted; re-sealing

Weight loading; anchor point locations

Parapets? Required walkpads?

Electrical, data

Baseball fields? Copper swap meet?

Benefits: Use of available space; often hidden from view; more economical; close to interconnection point; typically more secure areas.

Design Considerations: Carports

Considerations:

- Site-use planning
- Parcel ownership
- Parking lot orientation
- Shading from trees, buildings, power lines
- Accessibility
- Soils report
- Obstacles
- Structure type
- Location of interconnection points
- Aesthetics
- Additional uses
- Damage or theft hazards

Opportunities and Constraints:

Move or stop operations; re-purpose

Usable? Able to interconnect?

South-facing = good; north = not so good

Shade kills solar production

Vehicle heights; operational impact

Water table; rock

Trees; light poles; grass/bio-swales

Fixed-tilt; tracking; “blanket”

Electrical, data; trenching

Paint; structure; trim

Shade; rain-proof?; truck wash; lighting

Baseball fields? Copper swap meet?

Benefits: Use of available space; secondary goals; high-visibility “green” project; often close to interconnection point.

Design Considerations: Ground-Mounts

Considerations:

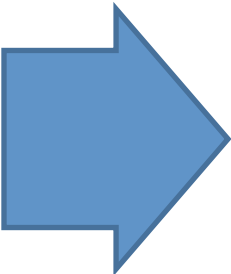
- Site-use planning
- Parcel ownership
- Slope orientation
- Shading from trees, buildings, power lines
- Accessibility
- Soils report
- Obstacles
- Structure type
- Location of interconnection points
- Damage or theft hazards
- Extra maintenance

Opportunities and Constraints:

Move or stop operations; re-purpose; CEQA
Usable? Able to interconnect?; setbacks
South-facing = good; north = not so good
Shade kills solar production
Roads, slope
Water table; rock; brownfield?
Trees; grass/bio-swales; protected areas
Fixed-tilt (ballasted, drilled, driven); tracking
Electrical, data; trenching
Baseball fields? Copper swap meet?
Weed abatement; dirty locations

Benefits: Use of available space (brownfields); typically low visual-impact areas; more economical; greater viability of tracker systems.

Project Management & Commissioning

- Contract and scope review
 - Design and engineering review
 - CEQA compliance
 - Materials acceptance
 - Permitting
 - Rebates and interconnection application
 - Schedule and operational impacts
 - Crew safety and accessibility
 - Line locating
 - Special inspections
 - Drilling/trenching/boring
 - Interconnection and shut-down
 - Aesthetic issues
 - Inspection and PTO
 - As-Builts and staff training
 - Data connection, monitoring, kiosk
 - Independent performance verification
- 
- Production and component requirements
 - System sizing; code compliance
 - Categorical Exemptions, Mitigated Neg Dec
 - Stainless, galvanized, painted, Al, fiberglass
 - Building, Planning, Fire
 - CSI and PG&E
 - Planning
 - Focus and logistics
 - SAFETY
 - Underground, welding, concrete, roof
 - Operational impacts
 - Operational impacts
 - Paint, design, trim
 - Building Dept and PG&E
 - String charts, emergency operations
 - Internet monitoring and public access
 - Confirm expected performance

Operations & Maintenance Issues

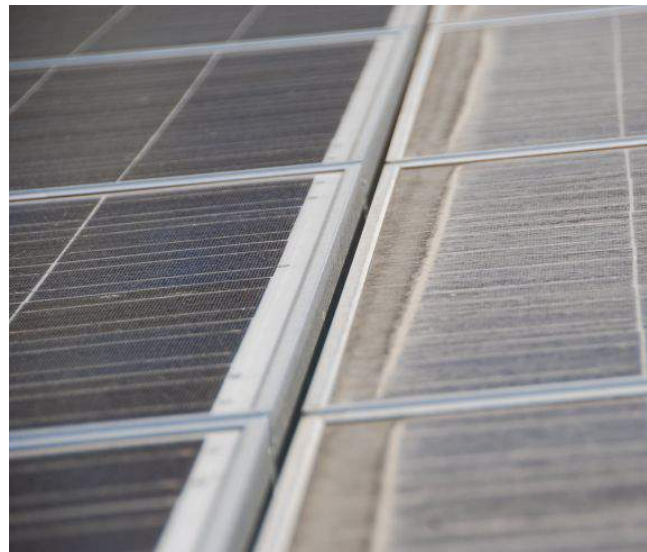
Performance Management:

- **Monitoring**
 - On-site irradiance and power measurements
 - On-line system monitoring
- **Purchase or Lease**
 - Self-perform
 - Installer or 3rd-party O&M provider
- **Power Purchase Agreement**
 - Owner/installer



Cleaning & Inspection:

- Module cleaning
- Inverter cleaning
- Fuse and wiring check



Questions



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Next steps

Visit www.solarroadmap.com/case-sv

or

Setup an individual consultation call for your site:

Eileen Hays, CASE-SV Project Manager

eileen.hays@optony.com

(408) 567-9216

About Optony

Optony develops and deploys solar best practices across the entire solar project lifecycle for government agencies, schools and commercial organizations.

"Optony's consulting service is a must-have for any organization considering an investment in solar. Based on Optony's comprehensive analysis and recommendations, we now have a low-risk, high-return solar strategy."

www.optony.com

