



Integrating Solar PV: Strategies and Case Studies

Jay Paidipati

Director

Navigant Consulting

Introduction and Agenda

- **Session Objectives:**
 - Provide update on the Better Buildings Alliance's Renewables Integration Team
 - Present case studies and strategies from successful solar PV projects on commercial buildings
- **Agenda**
 - Introduction – Jay Paidipati
 - A Commercial Building Owner Perspective – Eugenia Gregorio
 - Solar PV Case Studies – Matt Lynn
 - Commercial Solar Case Study – Mark Manthy

Renewables Integration Team Summary

- **Goals and Objectives**
 - Individual members often do not have the resources or expertise to address these very specialized issues, and vendors selling renewables projects have a vested interest in promoting their solutions.
 - Provide unbiased advice and shared experience to help BBA members navigate complex regulations, business models, and utility policies associated with distributed renewable energy systems.
 - Deliver projects based upon member interests and needs
- **Project Team Lead: Jay Paidipati, Navigant Consulting**

Team Activities

Current Work

- Hospitality Solar Guide
- Healthcare Solar Guide
- Promoting Solar PV on Leased Buildings Guide
- Supporting Case Studies
- Request for Information

Upcoming Work

- Coordinate with SunShot Program
- Market Recent Work
- Team Meetings

Request for Information

- Background: DOE's SunShot Initiative and BBA are exploring the best strategies to support, expand, and streamline efforts to deploy PV on and for commercial buildings in the U.S. real estate market.
- Drivers: Understanding the benefits and most prominent challenges for building owners, tenants and other stakeholders is essential for developing resources and solutions to promote solar installations in this market.
- Purpose: solicit feedback from building owners and building tenants, academia, research laboratories, government agencies, and other stakeholders on issues related to installing solar on commercial buildings.
- Where: <https://eere-exchange.energy.gov/>

Presentations

- Eugenia Gregorio, The Tower Companies
- Matt Lynn, Lend Lease
- Mark Manthy, Direct Energy Solar

Integrating Solar PV: Strategies and Case Studies

A Commercial Building Owner Perspective

Better Buildings Summit

Thursday May 28, 2015

Eugenia Gregorio

Director of Corporate Responsibility

The Tower Companies



Company Overview

- **Family-Owned, Privately-Held
Real Estate & PM Firm**
- **Locally-Focused**
- **Develops, Owns & Manages**
- **Over 5 million SF of commercial
office, multi-family residential,
and retail centers**
- **Leader in Green Building Industry**



Sustainability Leadership

Lead by example on environmental responsibility, by developing and managing high performance properties, being a global voice on environmental stewardship, and sharing our sustainable and innovative practices.



The Climate Registry



Goal: 20% by 2020

TOWER COMPANIES

Energy and Water Performance

ENERGY PERFORMANCE

Cumulative (vs. Baseline) **10%**

Annual (2013) **3%**

WATER PERFORMANCE

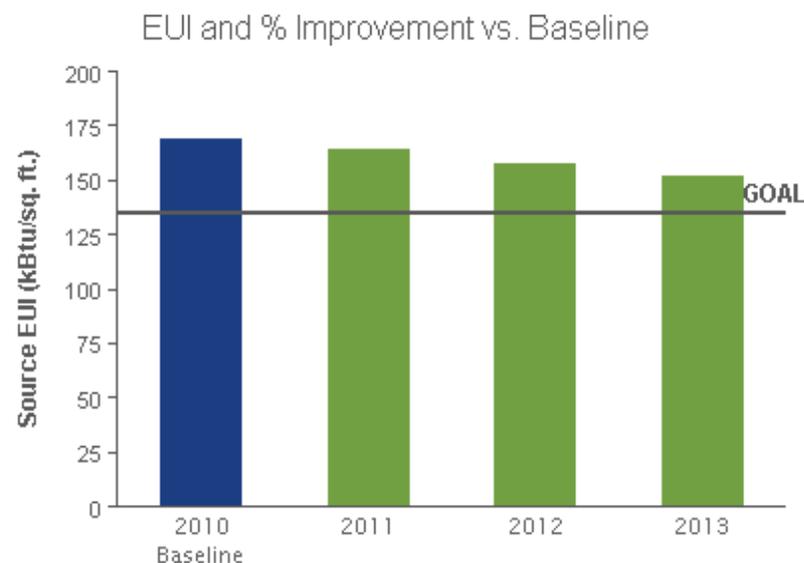
Cumulative (vs. Baseline) **14%**

Annual (2013) **4%**



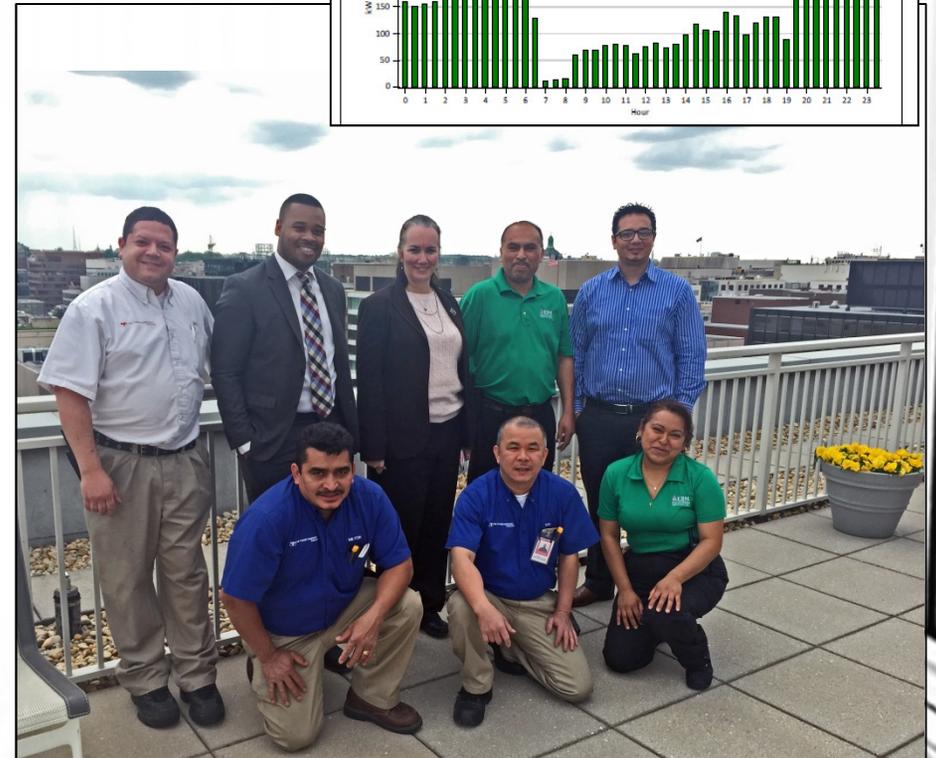
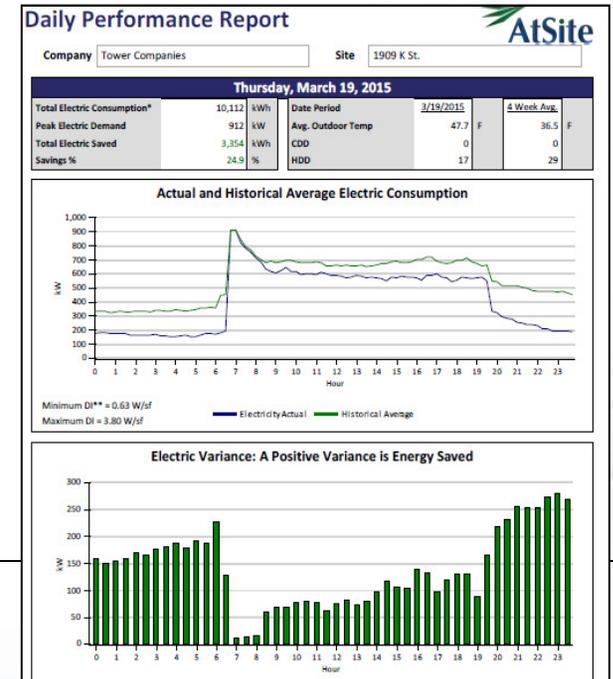
PORTFOLIO ENERGY PERFORMANCE

Better Buildings Challenge Partners strive to decrease portfolio-wide source energy use intensity (EUI) and to increase the percent improvement compared to a set baseline. Tower has committed 10 buildings that they both own and manage, which make up 3 million square feet of multi-tenant commercial office and multi-family high-rise residential properties. Compared to a 2010 baseline, Tower has improved energy performance by 10% due in large part to implementing a Real-Time Energy Management Program focused on low-cost ECMs and sustainable operations, LED lighting retrofits, BMS control upgrades, and equipment upgrades. There are other properties that The Tower Companies owns but that are not managed directly and therefore, aren't being included in this program.



Energy Conservation Measure Best Practices

- ✓ Real-Time Energy Management
- ✓ Align Building Operations with Lease Hours
- ✓ Night Audits
- ✓ LED Lighting
- ✓ Green Lease Guidelines
- ✓ BMS & Equipment Upgrades
- ✓ Set-point modifications
- ✓ Green Teams & Engagement
- ✓ Renewable Energy



The Millennium Building Sustainability Features

ENERGY



OFFSET
100%
OF ENERGY
CONSUMPTION



Rating of
86



DC'S FIRST
PV SOLAR
ARRAY FOR A
CLASS A BUILDING



20% REDUCTION
GOAL BY 2020

LEED



A PREMIER LEED
GOLD BUILDING –
WASHINGTON, DC'S
FIRST LEED-EB OFFICE
BUILDING

GREEN LEASE
GUIDELINES
FOR ALL
CLIENTS

Clients automatically qualify for 25+ points, half the points needed for LEED Commercial Interiors v2009

WASTE



INDUSTRY-
LEADING
COMPOSTING
PROGRAM



WASTE
MANAGEMENT
OVER 50% LANDFILL
DIVERSION RATE
ABOVE THE NATIONAL
AVERAGE

WATER



EFFICIENT
BUILDING
COOLING
TOWER



RAIN
BARREL
FOR
IRRIGATION



LOW
FLOW
FIXTURES



15%
REDUCTION IN
WATER USE

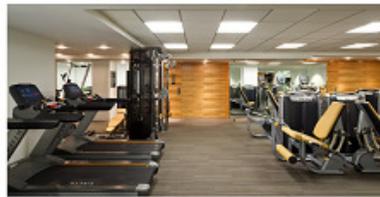


VISION STATEMENT

The Tower Companies envisions a world where buildings inspire and enrich the lives of their occupants, and create positive social change. In this world, people seek out buildings that better their health and well-being, connect them to thriving communities, and help to sustain the environment.

MISSION STATEMENT

The Tower Companies owns, develops and manages commercial, retail and multi-family residential properties in the DC metro area, while being mindful of our global impact. Our buildings are among the most sustainable in the world, blending sophisticated design, smart growth principles, unparalleled amenities and unrivaled service in a way that transforms expectations about real estate and improves the way people live, work, and play.



Fitness Center



Rooftop



INDOOR AIR QUALITY

- 100% building-wide exchange of fresh air every 55 minutes
- Air is double scrubbed - removing 80% of the airborne toxins from the "fresh" outside air
- Biannual Air Quality Assurance inspection to ensure healthy and productive environments for clients



HEALTH & WELLNESS



WELLNESS
ROOM



LACTATION
ROOM



YOGA
ROOM



MASSAGE
ROOM



SEASONAL HERB
GARDEN
FOR CLIENTS



ROOFTOP TERRACE
360° VIEWS OF DC



CSA PROGRAM
OFFERED TO
CLIENTS



CLIENT ONLY
FITNESS FACILITY
WITH TOWEL SERVICE

TRANSPORTATION



SECURED
& CONDITIONED
CLIENT BIKE ROOM



2 EV CHARGING
STATIONS
IN GARAGE



PREFERRED
PARKING FOR
HYBRID CARS &
EXPECTING MOTHERS

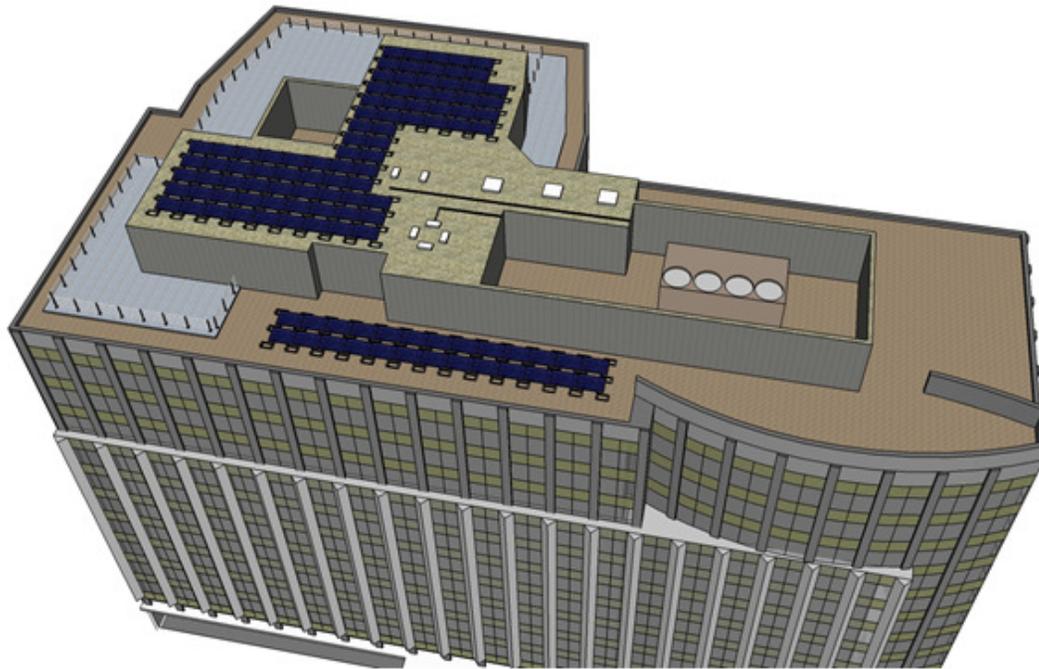


2 BLOCKS
METRO ENTRANCE
ACROSS THE STREET

Project Highlights

The Tower Companies - 1909 K St, Washington, DC 20006

Solar Panel Design



TOTAL SYSTEM SIZE

29.43 kW

OF 270W PANELS

109

ESTIMATED ANNUAL PRODUCTION (kWh)

37,612 kWh

Motivations & Financing



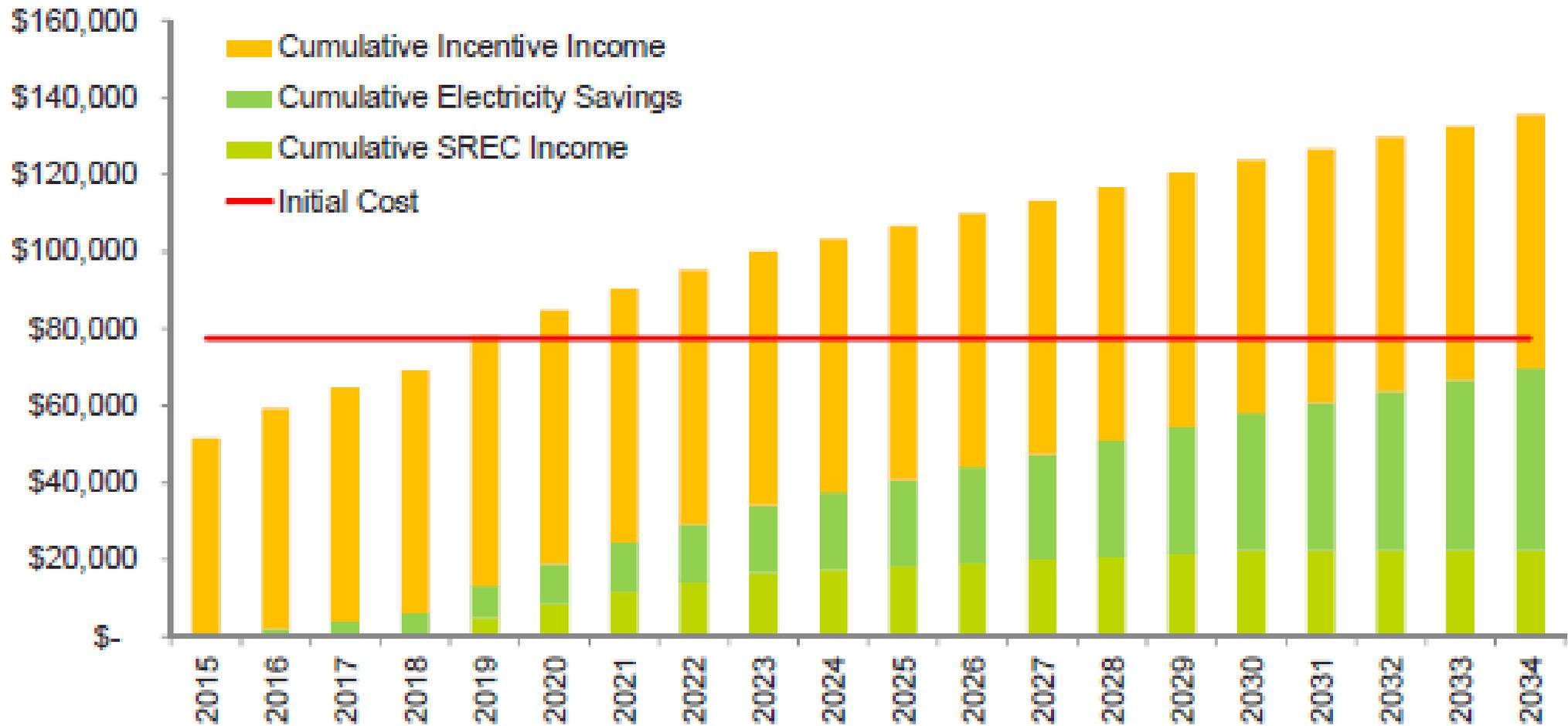
- ✓ **Long-Term Perspective**
- ✓ **Environmental Leader**
- ✓ **Financial Incentives**

- ✓ **Electricity Avoidance**
- ✓ **SREC Sales**
- ✓ **30% Federal Tax Credit**
- ✓ **Accelerated Depreciation**
- ✓ **40% Upfront Credit**

IRR 14.3%

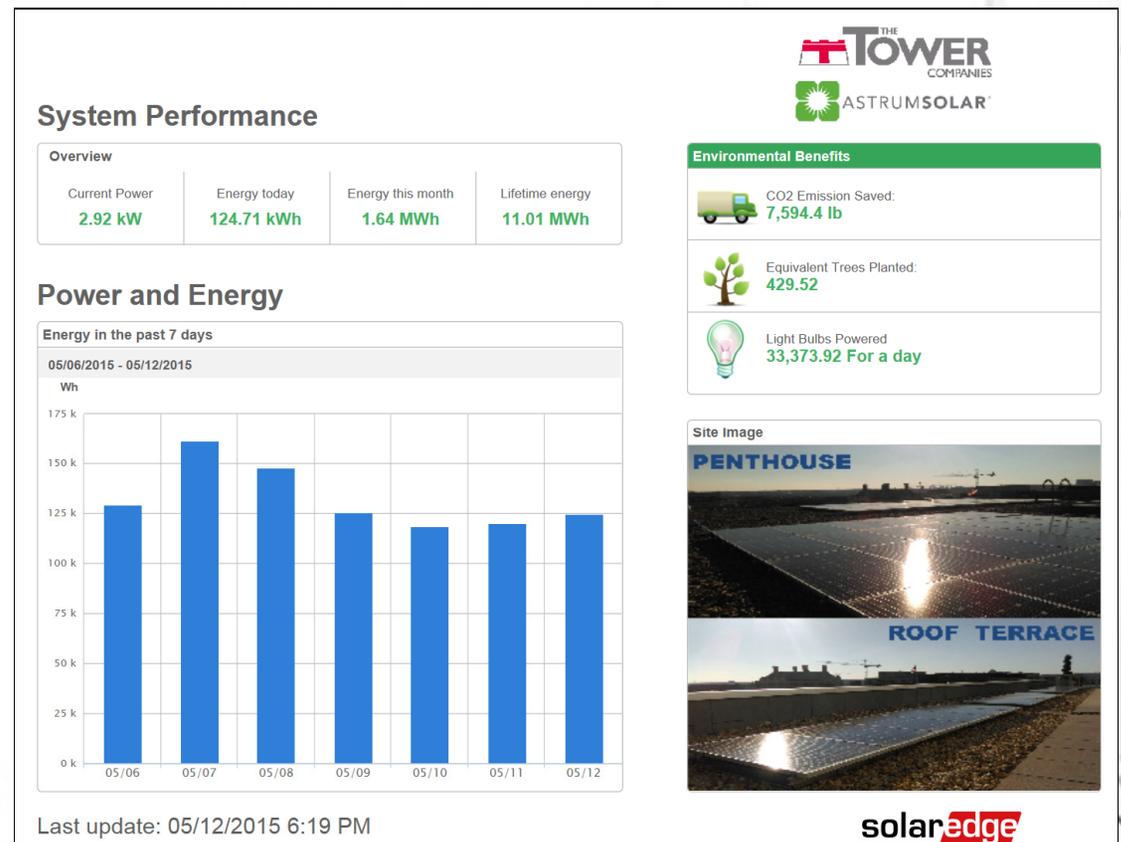
NPV \$27,547

CASH FLOW ANALYSIS

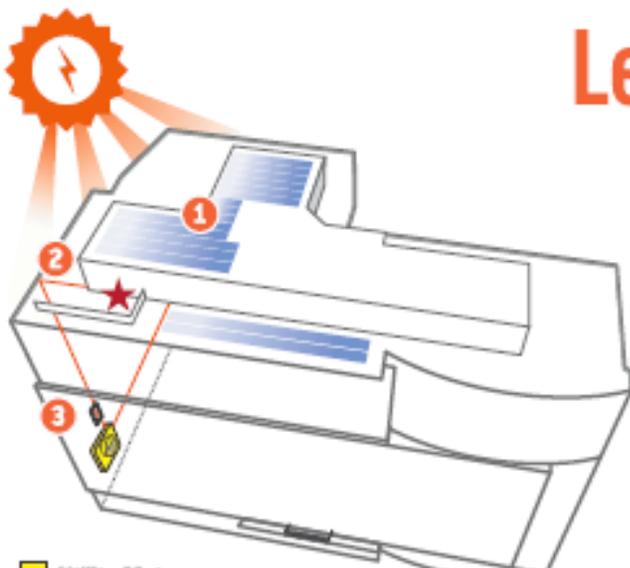


Challenges & Solutions

- ✓ Industry Experience
- ✓ New Process for Government Agencies
- ✓ Financial Incentives
- ✓ Design Modifications
- ✓ Education for Clients



Educational Signage



Learn How Our Solar Panels Work

- 1 In this photovoltaic (PV) system, solar panels capture sunlight and produce direct current (DC) electricity.
- 2 The PV system converts this clean power into the alternating current (AC) electricity that our building needs.
- 3 Once converted, AC electricity flows through our building's electrical system to reduce the need to purchase energy as well as our carbon footprint.

The Millennium Building's solar PV installation in 2014 was the first ever on a Class A commercial office building in Washington, D.C. The 30kW solar PV array consists of 109 American-made panels.

Utility Meter
★ You are here
Solar Panels



THANK YOU!

Eugenia Gregorio

Director of Corporate Responsibility

Eugenia.Gregorio@towercompanies.com

301.692.1463



LEND LEASE ENERGY DEVELOPMENT GROUP



DELIVERING CLEAN,
RELIABLE AND
AFFORDABLE ENERGY
SOLUTIONS



Leadership
in Energy &
Sustainability



Energy
Conservation
& Efficiency



Environmental
& Energy
GMRs



Energy Policy
& Action Plans



Renewable
Energy
& Storage



Green Retrofits



Utility
Awareness &
Education



Client
Relationships



BBC Partner
Commitment



Building Energy
Management
Systems (BEMS)

OUR VISION

CREATE THE BEST ENERGY SOLUTIONS



MORE THAN
40,792
HOMES

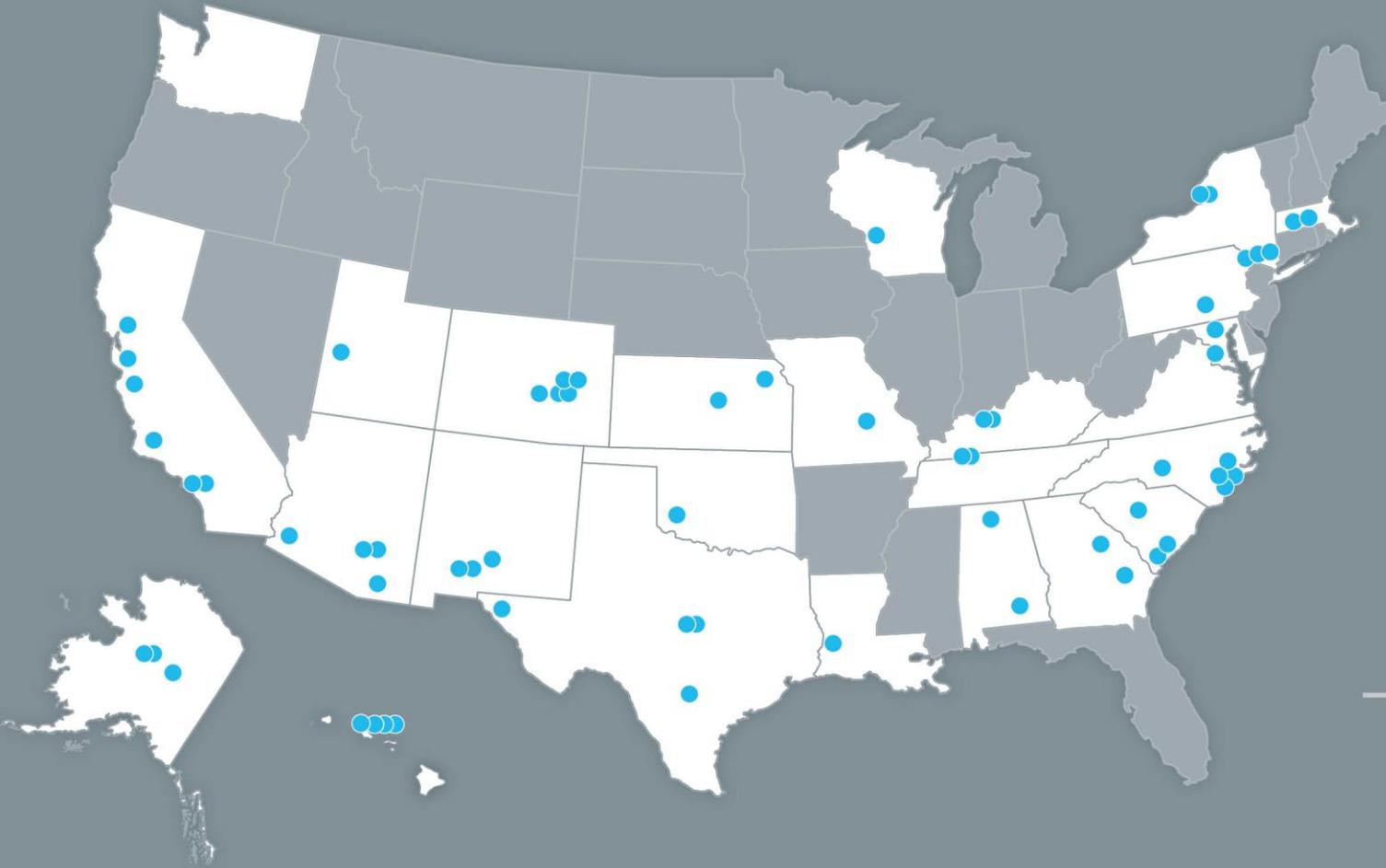
NEARLY
12,000
PRIVATIZED
HOTEL ROOMS

Experience gained
providing energy
solutions & security
for facilities – DOD
facilities across the US

LEND LEASE

THE DOD'S LARGEST PRIVATE SECTOR PARTNER

FOR THE DEVELOPMENT OF COMMUNITIES & HOTELS



OUR COMMITMENT

BETTER BUILDINGS CHALLENGE

Renewable Funding
Abundant
Green Campus Partners



Lend Lease accepted President Obama's Better Buildings Challenge and committed to achieving a 20% reduction in energy consumption for our entire military housing and hotel portfolio by 2020.

We are proud to announce we hit our goal early, achieving a 25% reduction as of December 31, 2014.



OUR DELIVERY

68

MEGAWATTS

Lend Lease Military Housing locations are currently generating or in development of

68 megawatts of on-site solar electricity.

SOARING HEIGHTS COMMUNITIES

At Davis Monthan AFB, **3.4MW** of ground mounted solar arrays and **2.7MW** of rooftop solar arrays, totaling more than 80,000 solar array panels.

At Holloman AFB, over 600 solar photovoltaic rooftop arrays atop duplex and single-home residences, totaling approximately **3.1MW** of solar power.



Lend Lease



OUR DELIVERY



ISLAND PALMS COMMUNITIES

18MW rooftop solar power that will provide approximately 30% of its community's energy needs.

Upon completion it will be one of the largest solar-powered communities in the world.

HICKAM COMMUNITIES

3.4MW of rooftop solar power generated will offset more than 185 million pounds of CO2 emissions over the next 20 years.

TIERRA VISTA COMMUNITIES

4.0MW of rooftop solar power spread across Peterson Air Force Base, Schriever Air Force Base and Los Angeles Air Force Base.

171 RESIDENTIAL ROOFTOPS CASE STUDY

STEWART TERRACE, NEWBURGH, NY



PROJECT OVERVIEW

Deal Structure	20 Year Power Purchase Agreement (PPA)
Total Project Capacity	795kWdc
Estimated 1st Year Production	938,100 kWh
Current Annual Usage at ST	2,300,000 kWh
Project Offset	40.8%
Current Electricity Rate	\$0.1528/kWh
PPA Price	\$0.1325/kWh with 1% escalator
20 Year Projected Savings (3% esc)	\$1,182,178
30 Year Projected Savings (3% esc)	\$3,936,302

COSTS

Total Costs – Development, Financing and EPC	\$2,800,000
Federal Tax Credit – 30%	-\$750,000
NYSERDA State Incentives \$1.00/watt	-\$795,000
Total Costs to be financed	\$1,255,000

Costs do not include fixed maintenance, insurances, state sales tax, inverter replacement, depreciation, etc.

KEYS TO SUCCESS

1. OFFTAKER WITH FAIRLY HIGH ELECTRICITY RATE
2. NYSERDA INCENTIVES
3. UTILITY NET METERING
4. UTILITY REQUIRED TO INTERCONNECT BY LAW

PRIVATIZED ARMY LODGING CASE STUDY
12,000 HOTEL ROOMS AT
40 ARMY INSTALLATIONS



\$1 BILLION INVESTED OVER 8 YEARS



CANDLEWOOD SUITES
17 NEW

STAYBRIDGE SUITES
1 NEW

HOLIDAY INN EXPRESS
69 RENO

PHASE 1: 10 MW PROGRAM AT 12 SITES



- Analyzed over **70 separate sites**
- **12 sites were selected** for solar development where savings could be achieved through a **Power Purchase Agreement (PPA)**

SITE SELECTION CRITERIA

- Utility Rate
- Hotel(s) Electricity Load – can solar be deployed at scale?
- Available Land, Rooftops and Parking Areas
Local Solar Resources
- EPC Costs including Interconnection
- Local Incentives/Rebates
- Billing and Regulatory Environment

LESSONS LEARNED

- Robust Stakeholder Engagement Plan –
offtaker, utility, city officials, congressman, DOE,
state sustainability associations, other influencers
- Understand all Federal and
State incentives/rebates
 - Federal and State Investment Tax Credits
 - State Renewable Portfolio Standard (RPS)
 - State and Local Incentive Programs
 - SRECs, community solar, etc. utility rebates
 - Property and Sales Tax Exemptions
- Understand metering and billing structure at a very detailed level,
how will each account number be affected by planned solar?
- Understand net metering laws in each state
- Obtain Detailed Consumption Data (load per meter), 15 minute data if possible
- Understand regulatory environment in each state – are 3rd party PPAs allowed by law?
What is best financing option – PPA, Lease, Cash
Purchase, ESPC, PACE financing, etc.?
- Does Customer have tax liability and appetite to invest in project?



OUR APPROACH

CORE CONCEPTS AND TECHNOLOGIES



CONSERVATION & EFFICIENCY

- LIGHTING
- HVAC
- BUILDING ENVELOPE

BUILDING ENERGY MANAGEMENT SYSTEMS

- SOFTWARE
- HARDWARE

DISTRIBUTED GENERATION & STORAGE

- GEOTHERMAL
- SOLAR
- STORAGE
- WIND

OUR APPROACH



ENERGY SOLUTIONS & SECURITY STRATEGIC OBJECTIVES

Our Approach and Rationale

PROJECT OBJECTIVES

VISION

INDEPENDENCE

Ultimate goal is strive towards 'independence' from the grid (and net zero where feasible) to ensure resilience of supply and sustainability of economic operations.

ECONOMIC OBJECTIVES

PROJECT COMPANY FREE CASH FLOW

Improve Project Co. NOI over time – reinvest savings into core facilities for residents

LONG TERM HEDGE

Mitigate volatility of energy prices and future escalation

QUALITATIVE OBJECTIVES

CHANGE THROUGH LEADERSHIP

Showcase the DoD and Lend Lease as market leaders – a catalyst for change. Enable our client and utilities to achieve their energy goals

ENVIRONMENT

Benefit the environment through less energy consumption and more efficient and cleaner forms of energy generation

STRATEGIC OBJECTIVES

BASE PORTFOLIO WIDE ENERGY SOLUTIONS

Create solutions for the overall base where we have a MHPI presence

BEYOND DOD AND ENERGY

Create a “Living Utilities” business in the Americas, inclusive of energy, to support our development pipeline and strategic clients

Thank you.

For more information, please contact:

Matt Lynn

Director of Development, Energy Development

M 910.376.4628

matt.lynn@lendlease.com

www.lendlease.com



Small Commercial Solar | A Case Study

Mark Manthy

Direct Energy Solar

202.643.0344

Objective

- Let's analyze the real world numbers behind a commercial solar installation in Washington, DC, Maryland and Virginia.
- This will allow you to more clearly understand the huge differences that only a few miles can make in the economics of a solar installation.



Introduction

Who am I?

- I've been in 'the business' for over 5 years
- Live in Baltimore
- Boston College Undergrad
- UMD MBA
- 7.7 kW on my roof



Introduction

Who are we?

- **About Direct Energy**
- [Direct Energy](#) is one of North America's largest energy and energy-related services providers with over seven million residential and commercial customer relationships. Direct Energy provides customers with choice and support in managing their energy costs through a portfolio of innovative products and services. A subsidiary of [Centrica](#) plc (LSE: CNA), one of the world's leading integrated energy companies, Direct Energy operates in 46 states plus DC and 10 provinces in Canada. To learn more about Direct Energy, please visit www.directenergy.com.
- **About Astrum Solar**
- [Astrum Solar](#) is a leading national full-service residential solar provider, serving homeowners and small businesses in Connecticut, Delaware, New Hampshire, Maryland, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Virginia, Washington, DC, West Virginia, California, and Arizona. Astrum Solar's mission is to spread solar power to the rooftops of America and to ensure that its customers get the most out of their solar panels: the most energy generated, the most electricity savings, the most beneficial environmental impact, and the most joy each time they see a sunny day. Astrum Solar was on the Inc. 500 Fastest Growing Companies List in 2012 and 2013.

Introduction



CONTACT US: 800-903-6130
YOUR SUN. YOUR POWER. YOUR WAY™

[SOLAR DONE RIGHT](#) [SOLAR BY STATE](#) [BASICS](#) [CUSTOMER STORIES](#) [COMPANY](#) [BLOG](#) [GET STARTED](#)

INTRODUCING DIRECT ENERGY SOLAR

Take control of your electricity bill. Go solar the right way. We make it easy.

LET'S SEE HOW MUCH YOU CAN SAVE



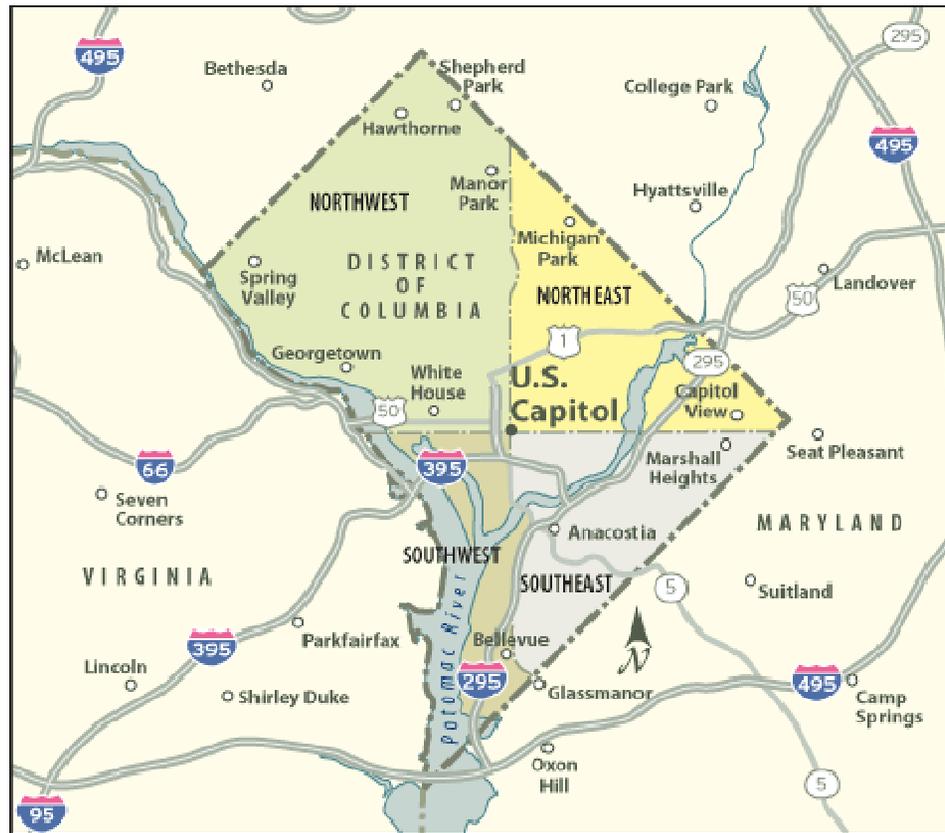
The DMV

For you out of towners:

District

Maryland

Virginia



The Project!

The Millennium Building 1909 K St, NW Washington, DC



Project Specs

109 Suniva 270 Watt Panels = 29.43 kW Solar
Edge Inverters with Optimizers
Flat Ballasted, no penetrations
Approximately 35,000 kWh generated per year
About 1% of total building usage



Project Specs

- Project owned and financed by the Tower Companies (Hi Eugenia!)
- Project is the first solar PV installation on a large, commercial, Class-A office building in Washington, DC.



Project Economics

1% of total building electricity offset by solar array!

WOW!

Seriously – what am I missing here?



Project Economics

Maryland

\$100,000 cost

-\$30,000 (Federal Tax Credit)

-\$1,765 (State Solar Grant)

=\$68,235

Annual PEPCO offset (at 35,000 kWh @ \$.14/kWh) = \$4,900

Annual SREC Production = 35 SREC * \$120 = \$4,200

Approximate annual income = \$9,100

**Not taking into account any depreciation

Project Economics

District of Columbia

\$100,000 cost

-\$30,000 (Federal Tax Credit)

=\$70,000

Annual PEPCO offset (at 35,000 kWh @ \$.14/kWh) = \$4,900

Annual SREC Production = 35 SREC * \$380 = \$13,300

Approximate annual income = \$18,200

**Not taking into account any depreciation

Project Economics

Virginia

\$100,000 cost

-\$30,000 (Federal Tax Credit)

=\$70,000

Annual Dominion offset (at 35,000 kWh @ \$.10/kWh) = \$3,500

Annual SREC Production = 35 SREC * \$40 = \$1,400

Approximate annual income = \$4,900

**Not taking into account any depreciation

Takeaways

- Location, location, location!
- **EVERY SITUATION IS DIFFERENT!**
 - Can you take the tax credit?
 - What are you paying for power?
 - Are you incurring a cost of capital?
 - What is an acceptable return?
 - Any depreciation concerns?
- Solar is **GREAT** and if you're in the right situation could be very profitable.

Thank You!

Mark Manthy

mark.mantry@directenergysolar.com

202.643.0344

Closing and Next Steps

Thank You!

- Thank you to our speakers
- Thank you for attending

Getting Involved

- If you would like to join the BBA or the Renewables Integration team, contact me at jpaidipati@navigant.com
- We are currently looking for case studies of solar PV deployed at leased buildings.