

Overview of Commercial Solar Systems

for NEO Assoc. Energy Engineers
April 21, 2016



Alan Frasz
President

Presentation Topics

- Why Solar Makes Business Sense
- Installing Solar on Your Property
- Types of systems with examples
 - Roof mounted
 - Ground mounted
 - Solar Canopies
- Installation concerns
- Typical costs
- Available incentives
- Economics and Return on Investment



Dovetail Solar and Wind

- Founded in 1995 - one of Ohio's oldest & largest renewable energy design and installation firms
- Implement Solar Electric, Wind, & Solar Thermal systems throughout Ohio and surrounding states
- Offices in Athens, Cleveland, Columbus, Cincinnati, Toledo, & Southeast Michigan
- Over 405 systems installed (15.5 MegaWatts - >58,000 panels!)





Why renewable energy?



- Provides energy independence and insulation from utility cost increases
- Payback is rapidly improving as solar become more efficient and lower cost, and as traditional energy sources continue to become more expensive
- Federal & State incentives greatly reduce payback time
- Renewable energy systems are an investment in our quality of life, our national security, and our environment
- Improve our air, water and reduce our carbon footprint

Climate Change Demands Action!



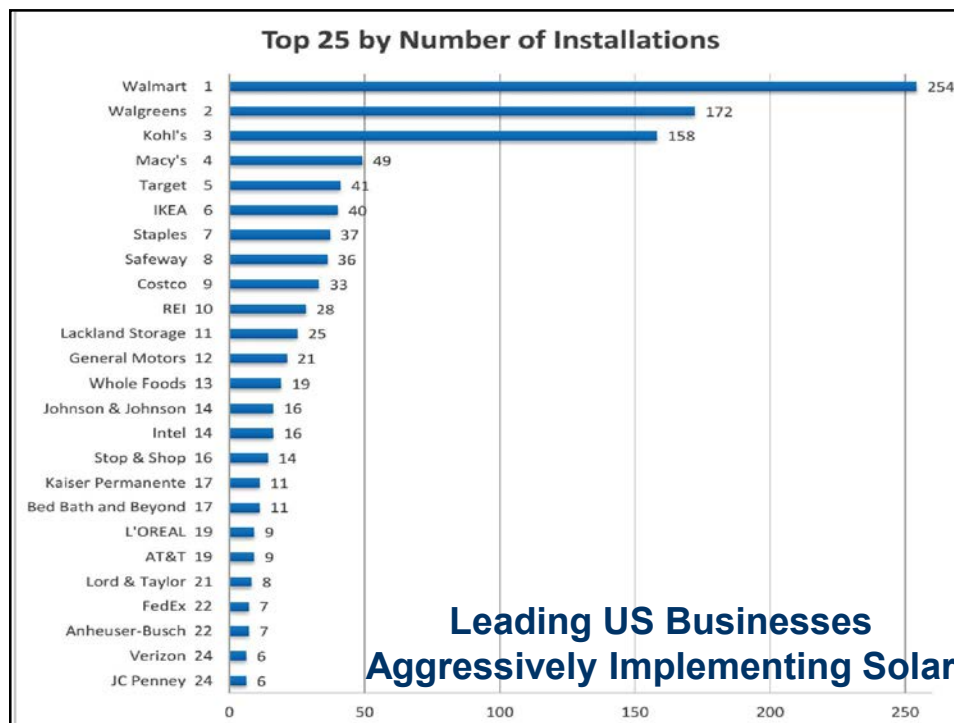
Solar Electric Systems Photovoltaics (PV)

- Photovoltaic cells convert sunlight into direct current (DC) electric energy
- Amount of light & temperature determines amount of current
- Inverter(s) convert to AC power compatible with your building & the grid
- Variety of types & styles
- Non-mechanical, maintenance free
- Work for 35+ years



Business Benefits of Solar

- Lock In The Cost of Electricity
- Reduce Impact of Electric Rate Increases on Business Cash Flow
(or your home budget)
- Move a portion of operational expenses to depreciable capital costs
- Provide more predictable operational costs
- Lower your carbon footprint
- Invest in your business rather than pay taxes and utility bills



Overview of Commercial Solar PV



Photos (clockwise from top): Toyota, Johnson & Johnson, Dow Jones & Company Inc.

Overview of Commercial Solar PV



Tech & Telecom	
Company	Installed Capacity (kW)
Apple	40,730
Intel	6,871
Verizon	5,424
AT&T	4,372

Automotive	
Company	Installed Capacity (kW)
Volkswagen	10,030
General Motors	6,699
Toyota	4,373
Ford	500

Retail	
Company	Installed Capacity (kW)
Walmart	105,141
Kohl's	50,205
Costco	48,083
IKEA	39,084

Health & Beauty	
Company	Installed Capacity (kW)
Johnson & Johnson	17,759
Kaiser Permanente	10,275
Walgreens	9,992
L'Oreal	6,839

Solar's Time Has Arrived

- Mature, Reliable, Proven Technologies
- Improved Efficiencies
- Good Material Availability
- Dramatically Lower Prices => Good ROI
- Great Federal Incentives
- Attractive Financing Now Available
- High Favorability and Desirably with Businesses & Consumers



Solar Performance Has Improved

Improved Module Efficiencies

- Example:
 - 2006: Sharp 200 watt 12.3% efficiency
 - 2016: SolarWorld 285 watt 17.0% efficiency
 - 20 to 21% efficiency available in commercial products for premium \$\$\$

Inverter Efficiencies Have Improved

- 2006: typically 93% to 95% efficient
 - 2016 : typically 96.5% to 98.5%
- More energy extracted per watt



Solar Prices Have Dropped Dramatically

- Typical Module Cost

2006: 200 watt module \$5.00 per watt

2016: 260 watt module \$0.77 per watt

30% more power at 85% lower cost!

- Installed System Cost

2006: ~ \$8.30 per watt

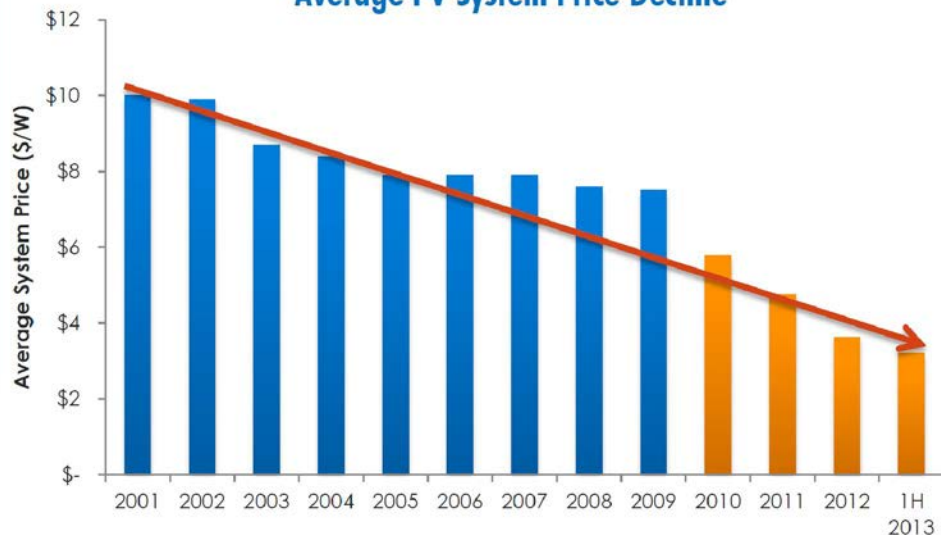
2016: ~ \$2.30 per watt

72% reduction in 10 years!

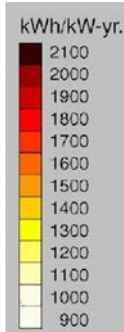


Solar Prices Have Dropped Dramatically

Average PV System Price Decline



Does Solar Work in Ohio?



Ohio



Germany

Insolation: A measure of the amount of sun falling on a specific location

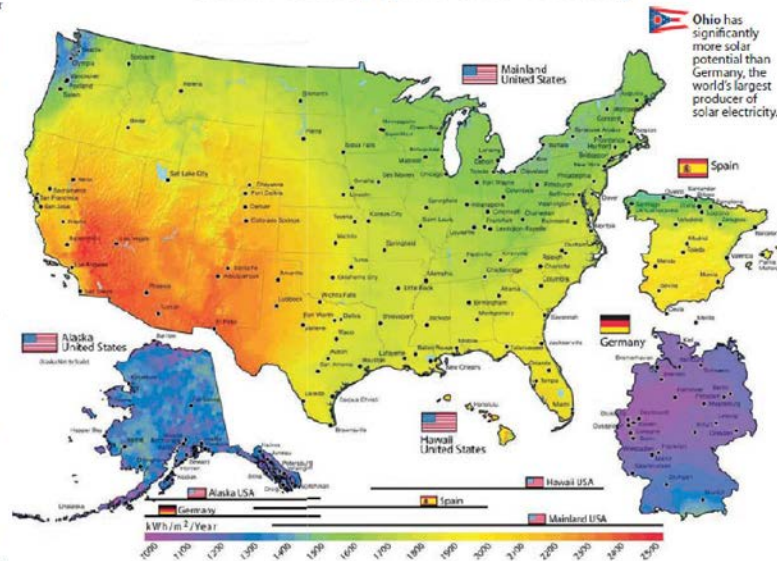
Even with less solar energy resource, Germany has 1,000 times more solar energy systems in production than Ohio.

Solar works in Ohio

Although many people think Ohio would not be an ideal place, the potential for solar energy use is promising. Ohio averages four to five peak sun hours daily. This accounts for the varying weather patterns that occur in Ohio throughout the year. With this level of sun energy, the state gets approximately 60 percent of the energy of Arizona and an estimated 40 percent more energy than Germany, which is one of the world's leaders in solar energy production.¹

Even when there isn't full sun available, solar panels still generate electricity. Germany is a great example of this. The country is one of the cloudiest nations in the world yet it still produces 1 percent of its total electricity through solar energy. Germany has been able to achieve its more than 3,800 megawatts (MW)² of solar energy through a variety of commitments to subsidize solar installations to make them more affordable and encourage its population to embrace renewable energy. The German government also instituted a feed-in tariff which pays residents with solar modules a subsidized price for electricity.

Photovoltaic Solar Resource: United States, Spain and Germany



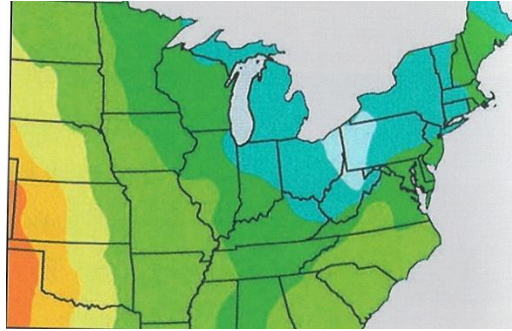
kWh/m²/Year = kilowatt-hours per square meter per year

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy at www.nrel.gov/gis

Available Sun Hours/day

Cleveland, OH
Average 4.2 Peak Sun
Hrs/Day
December = 1.7
June = 6.0

Miami, FL
Average 5.3 Peak Sun
Hrs/Day



Presentation Topics

- Why Solar Makes Business Sense
- ● Installing Solar on Your Property
- Types of systems with examples
 - Roof mounted
 - Ground mounted
 - Solar Canopies
- Installation concerns
- Typical costs
- Available incentives
- Economics and Return on Investment



How it works at your facility

- Solar generated electricity reduces what you need to purchase from your utility
- How much reduction is determined by your usage (demand), the size of system, time of day, time of year and weather
- Electricity can flow in both directions
- Net Metering provides business agreement and connection rules for interacting with the grid



Reducing your electric bill

- Onsite solar generation primarily reduces charges that are billed by the kilo-Watt-hour (kWh)
 - Generation charges
 - Transmission & Distribution charges
- May also enable you to reduce your Capacity charges
 - How much depends on your load factor and usage profile



Presentation Topics

- Why Solar Makes Business Sense
- Installing Solar on Your Property
- Types of systems with examples
 - Roof mounted
 - Ground mounted
 - Solar Canopies
- Installation concerns
- Typical costs
- Available incentives
- Economics and Return on Investment



Typical Flat Roof Installation Ballasted Mounting at 10° tilt



Orange High School, Pepper Pike, OH - 15.6 KW System



Newcomerstown
High School
131 kW Solar PV



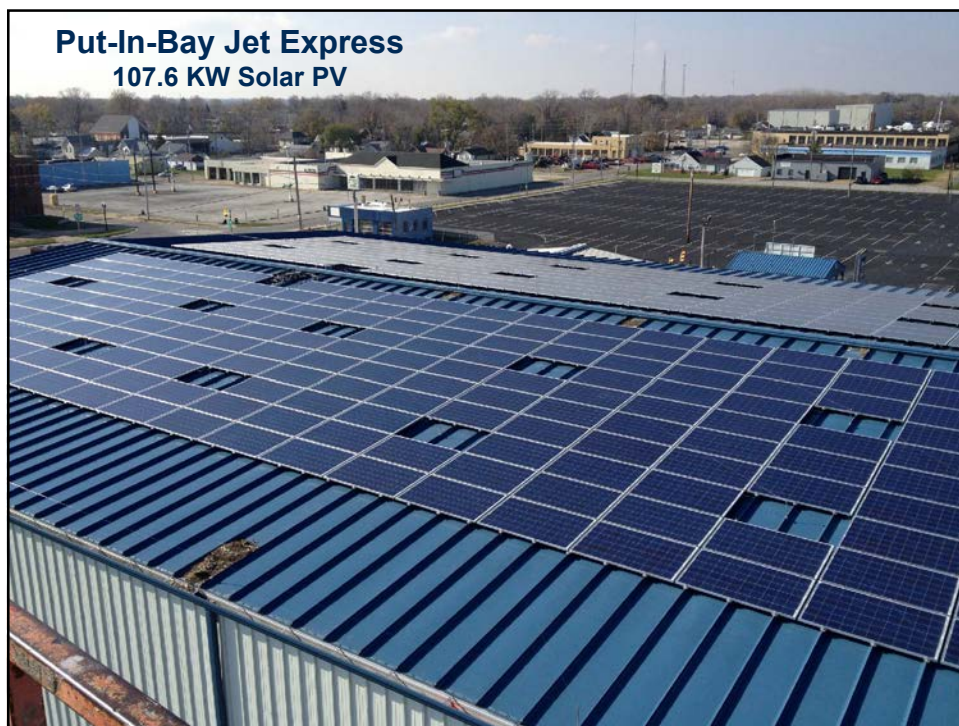




SJ Kuss Car Wash, Canal Winchester, OH
18.4 KW solar system on shingled roof







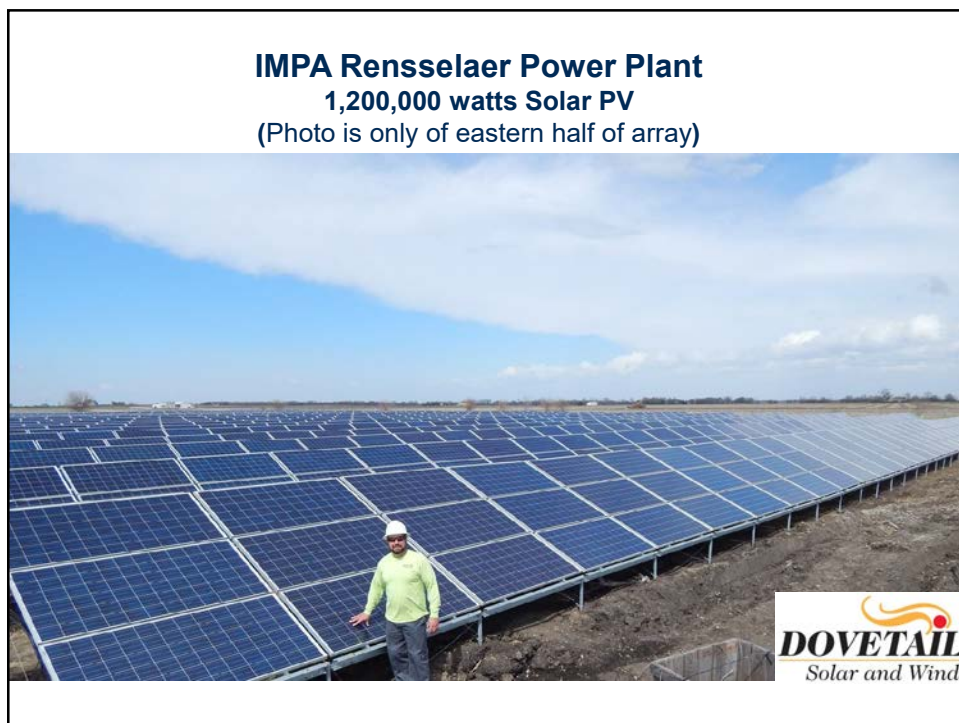


What if your roof space is limited?

- Other structures, such as awnings
- Ground mount on open land on your property near your building
- Solar canopies over parking areas or walkways











Solar Canopy Benefits

- High Visibility Installation
 - Differentiation => Solar the public can see!
- Shade on hot days, rain and snow cover when not
- Protects vehicles parked underneath
- Major benefit/perk for visitors or customers and employees
 - covered walkways to building add even more value
- Extends life of surface materials
- Additional lighting & architectural opportunities
- Advertising opportunities, if in a traffic area
- Acts as a banner to attract/retain Gen X and Y employees & upscale “green” customers



Burke, Inc.
369 KW Solar Canopies in Cincinnati, OH



Beautiful curved canopy structures on this 369 kW solar system over a business's employee parking lot in downtown Cincinnati



Brickwork & landscaping increases visual appeal

Dovetail pays attention to details throughout ...



Efficient LED lighting



Underside wiring



EV Charge Stations



Green islands to naturalize



Inverters screened by shrubs



Motorcars Honda
335 KW Solar Canopies in Cleveland Hts., OH



Motorcars Honda 335 kW Dual Barrel Solar Canopies

Street view



Monitoring & Kiosk Display

Monitoring is key to employee & public education and awareness

How much power is the solar system producing?
What are the environmental benefits?





Presentation Topics

- Why Solar Makes Business Sense
- Installing Solar on Your Property
- Types of systems with examples
 - Roof mounted
 - Ground mounted
 - Solar Canopies
- ➔ • Installation concerns
- Typical costs
- Available incentives
- Economics and Return on Investment



Site Concerns That Need Addressed

- **Roof Mounted Arrays** (\$1.80 to \$2.85/watt)
 - Shading from HVAC, other structures/buildings
 - Condition of roof
 - Weigh Capacity of roof (structural analysis)
- **Ground** (\$1.65 to \$2.50) & **Canopy** (\$3.65 to \$5.70)
 - Shading from trees or buildings
 - Zoning
 - Environmental conditions, such as flood plain
 - Underlying soil or structure



Important Considerations

- **Quality of Materials**
 - as in everything else, there are low, medium and high quality solar products
 - US Made? Factory Certifications?
 - History & Financial Strength of Manufacturers
 - Manufacturer Warranties and Term
- **Quality of Workmanship**
- **Training and Support**
- **Operations & Maintenance Requirements**



Other Important Considerations

- Qualifications of Installation firm
 - Licensed Electricians
 - NABCEP Certified Solar PV Installers
 - Intimate with Building & Electrical Codes for Solar
 - Example NEC 2014 Rapid Shutdown & ARC Flash Protection
 - OSHA Safety Trained & Certified
 - Drug Free Policies
 - Adequate Insurance Coverage
 - Firm Age & Financial Strength



NABCEP Professional Certification

- Independent Certification for professional system designs and installations that comply with all applicable codes.
- All legitimate PV installers should have at least one NABCEP Certified



- Additional employees can earn the NABCEP Entry Level PV Certificate™ or NABCEP Sales Professional Certificate



Presentation Topics

- Why Solar Makes Business Sense
- Installing Solar on Your Property
- Types of systems with examples
 - Roof mounted
 - Ground mounted
 - Solar Canopies
- Installation concerns
- Typical costs
- Available incentives
- Economics and Return on Investment



Typical price range (size matters!)

- **Roof Mounted Arrays** (\$1.85 to \$2.85/watt)
 - Size, type of mounting, height & accessibility, distance to building tie-in
- **Ground** (\$1.70 to \$2.50)
 - Size, type of mounting, soil conditions, distance to building tie-in
 - Environmental conditions, such as flood plain
 - Single or dual axis tracking
- **Canopy** (\$3.65 to \$5.70)
 - Size, type of mounting, height & accessibility, distance to building tie-in
 - Curved or flat or custom design
 - Parking lot or on top of parking garage
 - Underlying soil or structure
 - Waterproof (roof underneath, or not)
 - Other features: lighting, gutters, EV chargers



System Payback

- Depends on client specific parameters:
 - System size, orientation, tilt angle, efficiency
 - Solar irradiance (location in country)
 - Current electric usage & Utility rate(s)
 - State Net Metering rules
 - Tax rates
 - Financed amount & loan interest rate
 - Any planned efficiency improvements or increased electric usage



Impact of Electric Rates

- A key element in calculating payback for a solar system is the impact of future electric rate increases
- Wide range of utility rate structures across country
 - 7.5¢ up to over 25¢ per kWh
- Usually assume conservative 4% annual rate increase for financial projections
 - Typical Commercial rate is \$0.12/kWh
 - In Ohio, some users have seen >8% annual increase as we transition to new regulations
- Compounding effect has major impact on your future electric rates
- Solar generation profile offsets the most expensive (mid-afternoon) utility power



Ohio Energy Bills - Commercial Customers 8 Major Ohio Cities As of January 1, 2016

Cities	Electric Bill	Per KWH	Gas Bill	Per MCF	GCR Rate
Akron	36,112.13	0.12	175.61	3.82	2.39
Canton	30,696.74	0.10	175.61	3.82	2.39
Cincinnati	30,265.85	0.10	569.50	12.38	4.07
Cleveland	39,688.25	0.13	175.61	3.82	2.39
Columbus	28,552.24	0.10	355.19	7.72	3.66
Dayton	29,270.39	0.10	267.53	5.82	3.66
Toledo	38,960.81	0.13	355.19	7.72	3.66
Youngstown	36,112.13	0.12	175.61	3.82	2.39
Average	\$33,707.32	\$0.11	\$281.23	\$6.11	\$3.079

Based on Usage of 300,000 KWH, 1,000 KWD and 46MCF



Federal Tax Incentives Available

- Federal Investment Tax Credit (ITC)
 - 30% Tax Credit on Reimbursed System Cost
 - Must be installed by December 31, 2019
 - **No Cap** on size of system and credit
 - Residential and Commercial
 - Solar Electric, Solar Thermal, and Wind systems

<http://www.dsireusa.org>



Federal Tax Incentives Available

- Federal Modified Accelerated Cost Recovery System (MACRS) for Solar & Wind
 - 5 year Depreciation Schedule for Commercial
 - 50% Bonus Depreciation for 2016-2018
 - Depending on tax bracket, can cover up to 42% of system cost
- Ohio Provides Similar Schedule for State Depreciation



Solar Renewable Energy Credits

- Sell Environmental Attribute of solar energy generation to utility that is required to produce quantity of clean power or equivalent offset
- This is in addition to savings from the electricity produced by the solar system
- SRECs are commodities – prices fluctuate based on supply available
- Can represent significant value for larger commercial systems in Michigan
 - Ex. 100 KW Solar System produces 123,300 kWh/yr
 - = Earns $123 \times \$25 = \$3,075$ in one year



Example: 200 kW Commercial System

- Federal Tax Bracket: 35.0%
- Location's Avg Peak Sun Hours: 4.2 (Cleveland area at 10° tilt)
- Estimated Annual Production: 232,331 kWh/yr
- Starting Average Utility Rate: 10.5 ¢/kWh

List System Installed Cost (\$2.29 per STC DC Watt)	\$458,000
Federal 30% Investment Tax Credit	-\$137,400
MACRS 5 yr Accelerated Depreciation	-\$161,216
System Cost After Tax Incentives (34.8%)	<u>\$159,384</u>

Payback 7.7 yrs. IRR over 25 years is 9.7%



Example: 200 kW Commercial System

- Starting Average Utility Rate: 10.5 ¢/kWh with 4% annual increase

System Cost After Tax Incentives	\$159,384
---	------------------

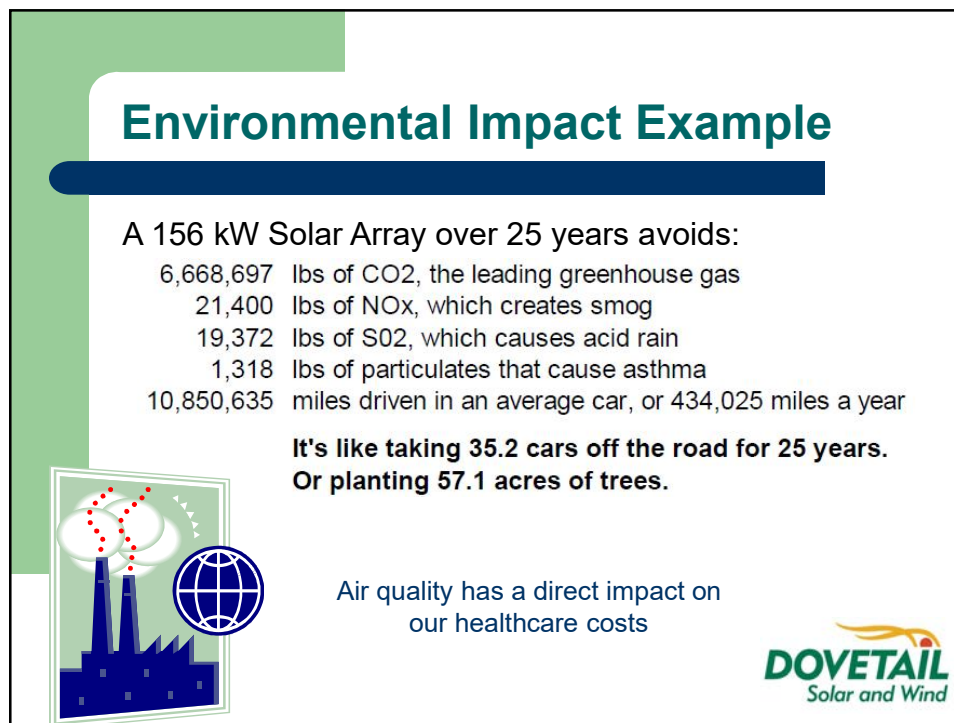
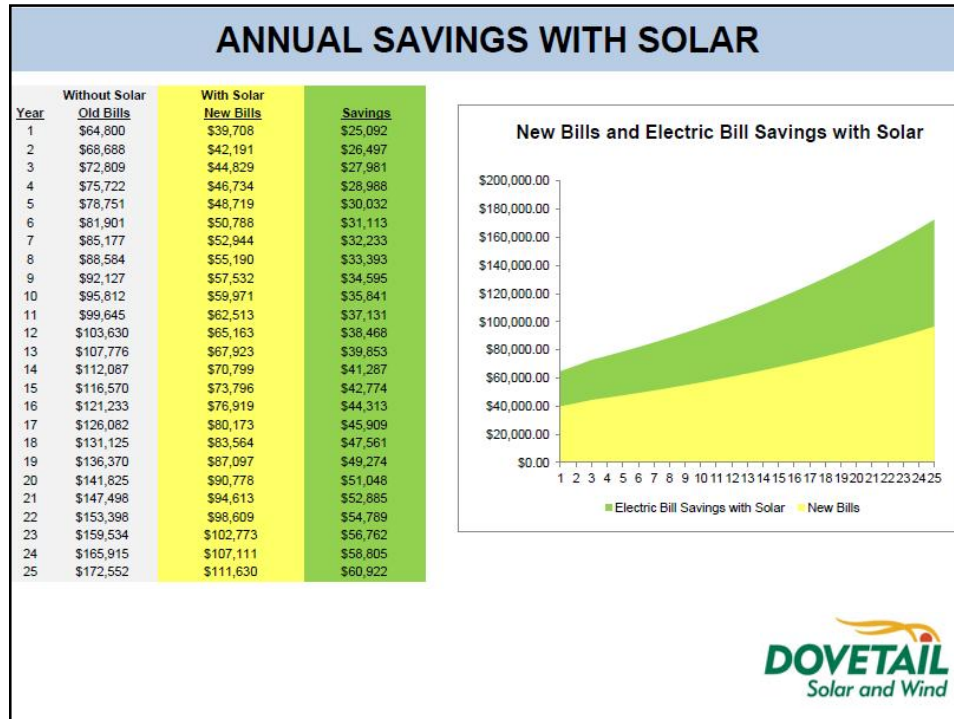
Electric Utility Savings

- **First year :** **-\$24,517**
- **25-Year Cumulative Net Savings:** **-\$612,120**

- **Total Lifecycle Payback** **3.6x**
- **Property Value Increase with 6% Cap Rate** **\$398,323**

Payback 7.7 yrs. IRR over 25 years is 9.7%





Other Tangible Benefits

- Increased Property Value
 - A Solar PV System Increases the Resale Value of Your Property
 - Government funded study found that home **Resale Values increased by \$20 for every \$1 of reduction in annual utility cost**
- Example
 - A 3.7 KW Solar System produces 4,168 kWh per year = \$542 per year
 - Increase in Property Value = 20 x \$542 = \$10,840
 - Increases as Utility Electric Rate increases



“Going Green” Has Market Value

WE'RE POWERING THE FUTURE WITH WIND

On August 1, 2006, we began using renewable energy to power 100% of our U.S. operations.

We believe this will not only help decrease traditional power generation emissions, but also take a small step toward addressing the worldwide problem of global warming.

Coldwater Creek

One Coldwater Creek Drive | Sandpoint, ID 83864 | 800.787.9196



“We at Johnson & Johnson take our corporate responsibilities seriously. By investing in solar electric generation, we make active our commitment to the environment.”

John Subacus

Director, Facility Management
Janssen Pharmaceutica Products, L.P.



Summary Benefits of Solar

- Lock In The Cost of Electricity
- Reduce Impact of Electric Rate Increases on Business Cash Flow
(or your home budget)
- Move a portion of operational expenses to depreciable capital costs
- Provide more predictable operational costs
- Lower your carbon footprint
- Invest in your business rather than pay taxes and utility bills



Discussion and Q&A

Dovetail Solar and Wind

Northeast Ohio Office

(216) 292-2900

Alan Frasz

afrasz@dovetailsolar.com

www.dovetailsolar.com

