



Application of Solar PV Technology from a Business Perspective

Ed Liberty
Vice President, Dome-Tech, Inc.





Introduction

- Dome-Tech, Inc.; a UTC Company
 - Energy Engineering, Greenhouse Gas Reduction & Project Development Services
 - Retro-commissioning and Commissioning Services
 - Energy Procurement Services
 - Located in Edison, NJ with offices in NYC and the Philadelphia, PA area



United Technologies Corporation



UTC Fire & Security



Pratt & Whitney



Carrier



Otis



Sikorsky



Hamilton Sundstrand



Research Center



UTC Power

"Building Your Greener World"



UTC Global Leadership



Successful businesses improve the human condition. We maintain the highest ethical, environmental and safety standards everywhere.

2005 Award



Sustainable Cities Program

2005 Award



Global 100 Most Sustainable Corporations

1999-2005 Award



World Business Council for Sustainable Development

Energy Efficiency in Buildings Project

"Building Your Greener World"



Why Invest in a Solar PV project?

- You have taken all other low cost steps to conserve energy and reduce your carbon footprint,
- You want to do more,
- You are want to make a sustainable investment,
- And you want to do the right thing!



Typical Project Goals

- Reduce GHG emissions
 - Reduced use of grid power
- Reduce operating costs
 - “Free” power after investment is paid back
 - Or lock in a known long term rate for purchased power
- Earn a satisfactory return on investment
 - Viable use of client’s or investors’ capital
- Public image
 - Community, customers and employees



Where do I put it?

- Roof mounted systems
 - Minimal impact on land resources
 - Will likely have to be removed and reinstalled to replace the roof over its lifetime
 - Am I comfortable with an outside entity having access to my roof for 20 or more years?
- Ground Mounted systems
 - Highly visible
 - Long term commitment to land use
 - Low impact on site operations



Where do it put it?

- **Roof mounted systems**
 - Don't use valuable real estate, not readily visible
 - Fewer approvals
 - Structural considerations
 - Limited space dictates technology & limits inclination
- **Ground mounted systems**
 - Use valuable real estate; unless it's a brownfield!
 - Regulatory approvals; Planning & Zoning, Soil Conservation, DEP?
 - Accessible & Visible
 - Spacing flexibility allows for optimal inclination and tracking capability



What is Needed to Attract Owners and Investors?

- **Acceptable risk**
 - Project risk; can it be built and operated at the price I assumed? Will it operate/performance as advertised?
 - Technology risk; will it work?
 - Counterparty risk; will the customer pay? Will the investor maintain the system?
 - Regulatory risk; will the rules allow me to make money? Will I be able to
- **Acceptable returns**
 - IRR, ROIC, ROE, etc. are commensurate with the risk taken
 - Payback is reasonable



Why is Solar so Popular in New Jersey?

- Vision & Leadership of the BPU
 - Renewable portfolio standard
- Creation of a framework that balances the needs of stakeholders....
 - Population (present and future)
 - Rate-payers & Utilities
 - Investors
- And creates a viable climate for investment....
- Yet adjusts to allow improvements to the framework
 - Program evolves to drive results



What are the financial drivers of a solar project?

- Offset electric purchases from the grid by the host
- Sale of renewable energy credits
- Federal investment tax credit
- Accelerated depreciation



Are there subsidies?

- Not directly, but there are financial incentives that make investing in solar attractive
- Investment Tax Credits
- Accelerated Depreciation
- Renewable Energy Credits



What is a Renewable Energy Credit

- An attribute of energy produced from a renewable source; solar, wind, hydro, biomass, landfill gas, digester gas, etc.
- NJ has a renewable portfolio standard (RPS) that requires renewable energy content in every kilowatt sold in NJ
- Energy providers can buy/resell renewable energy or purchase credits to comply or pay a compliance penalty



GHG Reductions

- GHG reductions come from the avoidance of electricity generated from fossil fuels
 - Coal, natural gas and oil
- ~1095 lbs of CO₂ are avoided per Megawatt-Hour of electricity produced from a solar pv system in New Jersey



Typical Project Considerations

- Business structure; client owned or investor owned
- Project Location; roof mounted or ground mounted
- Technology selection
 - Solar PV panel selection; crystalline or thin film
 - Tracking capability



Business Structures

- Client owned
 - Client buys the system and owns it
 - Financed by debt or equity
 - Customer gets energy savings, tax benefits and RECs
- Investor owned
 - Investor buys the system and owns it
 - System installed on customer's property
 - Investor gets tax benefits and RECs
 - Customer gets energy savings and a known price of electricity



Technology Choices

	<i>Crystalline Panels</i>	<i>Thin-film PV</i>
Technology Maturity	Commercially available for the past 40 years.	Commercially available for the past 15 years.
Proven Longevity	40 year old systems still in operation.	Too soon to tell. However, most systems have 25 year warranties.
Method of Manufacture	Thin wafers are cut from a crystalline silicon block, and assembled in a panel with metal conducting strips.	Constructed by depositing very thin layers of photosensitive materials on backing such as glass, stainless steel or plastic
Sunlight-to-Electricity Conversion Rate	Up to 18.5%	Up to 12%
Power Density	8.7 watts per square foot	4.1 watts per square foot
Approximate Loading	5 pounds per square foot (Point load is 55.2 pounds per square foot)	12 ounces per square foot
Durability/Breakability	Rigid/ Impact resistant tempered glass surface	Flexible/ virtually unbreakable
Performance When Damaged	Degrades to zero	Slight reduction
Roof Attachment Detail	Panels are ballasted (not fastened to roof). Removal can be cumbersome.	Membranes are hot welded to the roof. Removal can be cumbersome.



Roof Mounted Application



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Ground Mounted Application



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