Presentation to Council Of Governments

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The Stella Group, Ltd.

The Stella Group, Ltd. is a strategic marketing and policy firm for clean distributed energy products which include advanced batteries and controls, energy efficiency, fuel cells, heat engines, minigeneration (natural gas), microhydropower, modular biomass, photovoltaics, small wind, and solar thermal. The Stella Group, Ltd. is one of the very few companies that blends distributed energy technologies, aggregates financing (including leasing), has contacts with almost every DG company, and has consumer friendly service with a focus on standardization.

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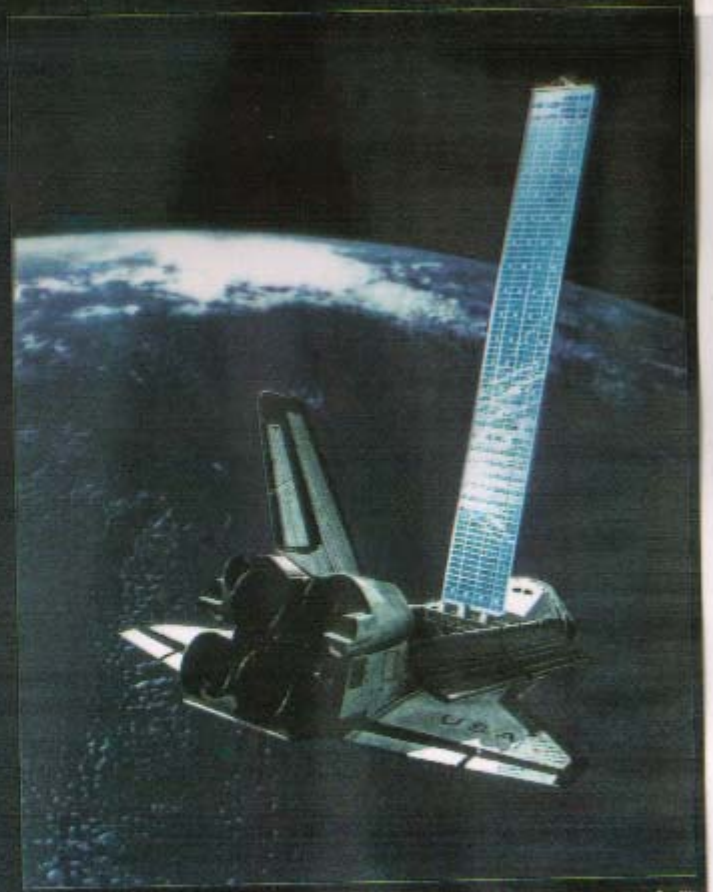
Photovoltaics is a universal power source. Though still a young technology, its strength is that it can be used anywhere. This book strives to highlight the myriad ways in which photovoltaics is already being used—then expand the ways we use photovoltaics (PV). PV is an enabling technology—and it can enable us to do things never dreamed of before.

Photovoltaics—often called "solar electricity," is the direct conversion of sunlight to electricity. When sunlight strikes a PV cell, electrical current and voltage are created—silently and cleanly. Because of this, PV is one of the most attractive alternative energy forms. The modern PV cell was developed in the mid-1950s. Shortly thereafter, it powered our first space satellites, and after several decades many of these PV-powered systems are still operating—a great witness for the reliability of this power source.

Terrestrial use began to be encouraged by the U.S. government in the early 1980s. These early projects sought to prove PV's reliability and competitiveness in practical field applications. Some of those early applications, such as the Coast Guard's aids to navigation, were embraced immediately. Today PV is the prime power source for all of the U.S. Coast Guard's navigational aids. Likewise, other military and governmental applications have proven irreplaceable, remote meteorological monitoring for example.



△ Photovoltaic cells were first used in space to power a 5mW backup transmitter on the Vanguard 1 in 1958. Sputnik used PV. Indeed, solar cells power most satellites in space today, and the U.S. shuttle fleet uses PV to generate much of its electrical power. *[Photo courtesy National Renewable Energy Laboratory from a Lockheed rendition]*

Why Distributed Generation

1. **Remote energy** — where you need it, when you need it
2. **Back-up energy** — critical functions when the electric grid goes down
3. **Power quality** — no surges or swells or transients damaging digital and other sophistacled equipment — not a problem 20 years ago
4. **Cost reduction** — offsetting demand charges, peak power rates, and even ratchet rates — heightened value with time-of-day metering and "smart" meters
5. **Consumer values** — independence and control, green energy, and/or a technical leader or trendsetter

Corollary Markets

Agriculture-water pumping, irrigation, electric cattle fences, co2 generators for grain and rodent control, pond aerators, greenhouse automation and heating.

Child Survival- water purification, vaccine refrigeration, remote health facilities, electricity for prenatal & post natal care

Communications- cellular repeaters, transmitters, batteries, packet radio, low-orbit satellites, back-up switches, and line augmentation

Democracy-electronic voting booths, computer powering, lighting and remote monitoring, lighting for education, all-time internet access

Education- school lighting, cafeteria and shower water heating, building ventilation, computer powering including internet access & distance learning.

Economic Development- microlending for solar, cottage industry powering (electricity, space heat & water heating), solar assembly and installation including micro-manufacturing

Emergency Preparedness- containerized power generators, sanijohn lighting and ventilation, area lighting, medivac power, water heating for food, solar cookers (hybrids), site charging computers and satellite phones

Environment-solar powered scooters, diesel generator replacement, water quality monitoring, conventional water heater displacement

Healthcare-vaccine refrigeration, ozonators, sterilization, on-site lighting, potable units, back-up water heating and power for hospitals as well as remote communication and internet

Monitoring- remote water and air monitoring, area-wide for emergency or crime prevention, flood warning (plain or dam), earthquake or snow slide

Reliability- back-up power and battery bank charging, substation augmentation, real time controls, back-up switching, redundant control systems (off-grid)

Tourism-water heating and pool heating, back-up power for lighting and ventilation, refrigeration and communications

Transportation-cathodic protection (rust prevention) bridges & railways, powering road signs and railway crossings, buoys and pier lighting, bus stops and street lighting, solar-charged scooters and car batteries

Water Quality-ozonators, RO and filtration systems, monitors, well pumping water heating, thermal distillation and pumping

Women-water pumping (40%), refrigeration/heating/drying (40%) and agriculture including drip irrigation

Early adopters of fuel cells are driven by the need for uninterrupted, high quality power.

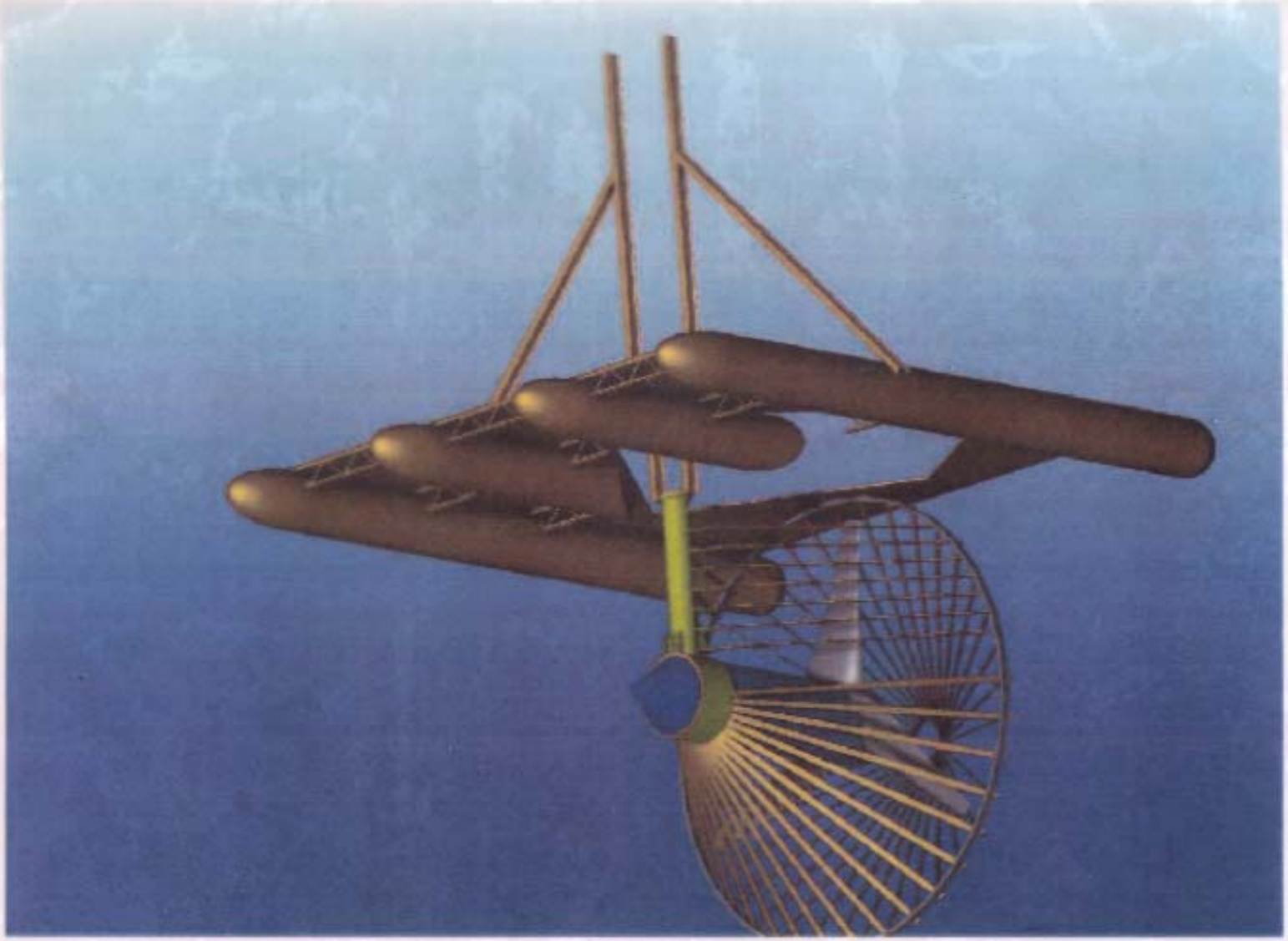
Power Disruption Events per Month

Event	Median	Average	Worst
Interruptions	1.0	1.3	10.0
Sags / undervoltages	4.1	27.9	1,660
Swells / overvoltages	3.4	13.9	1,450
Transients	15.7	63.5	1,166

Source: Duke Power, Sandia National Laboratories

- Power disruptions may cause sensitive equipment to fail.
- As a result, organizations face potential for significant losses – lost data, lost materials, lost productivity, and lost income – as well as risks to public safety.
- A study by Sandia National Laboratories estimates losses from power disruptions at more than $150 billion per year in the U.S.
- In response, more and more organizations are turning to on-site generation to boost power availability.

Nexus Associates, Inc.



10/27/02 VERDANT


SAINSBURY'S
© SERG

PowerShade™

POWERSHADE, UNIVERSITY OF WYOMING, LARAMIE, WY

Solar Electric Car Ports & Shade Structures

PowerShade* provides clean electricity while shading parked cars or picnic areas. PowerShade is a fully engineered, carport compliant system available as either a kit or installed system.

- **Modular Design.** Pre-fabricated units range in size from 4 to 6 auto parking spaces with 5kW to 40kW power per unit. The design accomodates both continuous and multi-level structures.
- **Weather-Tight.** PowerShade is available with all-weather roofing and wall units to offer as a complete shelter.
- **Electric Vehicle / Lighting Options.** Optional charging stations are available to convert sun power to fuel for electric vehicles. A night-lighting feature is also available for added safety and convenience.

* PowerShade is protected by US Patent No. D408354

The PowerShade system for GPU Solar produces energy for Green Mountain.com.

132 kW PowerShade parking structure.

POWERSHADE, HOPLAND, CA

PowerTracker™

Solar Electric Systems that Follow the Sun

PowerTracker rotates its solar panels to follow the sun from east to west, generating the maximum energy possible from an affordably priced ground-mounted system. PowerTracker incorporates robust active tracking motors to ensure optimal performance and stowing during high winds. Other PowerTracker features include:

- **More Energy.** Provides up to 35% more energy than fixed PV systems. Produces consistent power during most daylight hours for enhanced operational savings.
- **Tilted Axis of Rotation.** PowerTracker optionally features a tilted angle of rotation for high latitude sites.

TILTED AXIS POWERTRACKER

HORIZONTAL AXIS POWERTRACKER

SunCaddy™

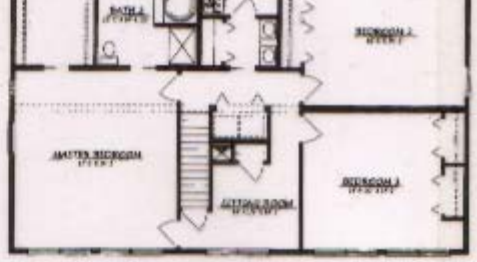
Solar Electric Systems for Golf & Utility Carts

SunCaddy* powers electric golf and utility cars from daylight, charging itself during use. Benefits include greater range, lower recharging costs, and extended battery life. SunCaddy is available for all major brands of golf and utility vehicles. Visit www.suncaddy.com.

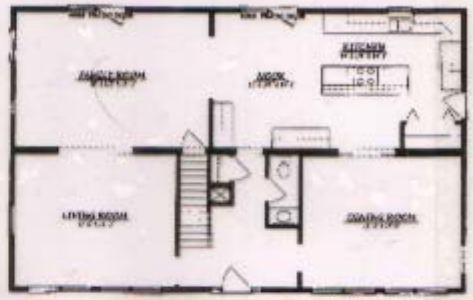
* US and international patents pending

Suncaddy made it's debut at the Senior

The Solar Patriot



Second floor



First floor

Floor
- 2x10 Floor Joists 16" on center
- ¾" tongue and groove plywood floor decking
- Congoleum vinyl over ¼ underlayment
- 25 oz. Carriage carpet over 6# ½" rebond pad

Interior Walls/Trim
- ½" gypsum drywall
- 2x4s 24" on center including marriage wall
- 3 ¼ white colonial base
- 2 ¼ white colonial casing
- 3 pinned mortise white 6 panel colonial doors
- Lever lock sets
- Stools on windows

Ceiling
- Flat/smooth/primed
- 5/8 gypsum drywall
- 8' Height

Electric/Plumbing
- Front and rear door chimes
- Hard wired fire detectors as per code
- 2 GFI outlets
- 8" Single lever Moen faucet with sprayer
- 8" stainless steel sink
- 4" Single lever Moen Faucet
- 30" vented range hood
- 40 place 200 AMP service panel
- Aker tub/shower and bathtubs
- Anti-scald Moen shower faucet
- Shut-offs at all fixtures
- Universal Rundell elongated 1.5 gpf toilets
- 50 gallon electric water heater
- Wired for dryer and electric range.
- Copper water feeds stubbed
- PVC drain, waste and vent lines
- 2 phone jacks
- 2 cable jacks

Exterior
- 36x80 insulated 6 panel colonial door (front)
- BHP door locks
- 36x80 9 lite steel rear door (rear)
- 12" Eaves
- 12" gable end overhangs
- 90# felt eave protection
- Thera-ply marriage wall sheathing
- ½" plywood roof decking
- Rolled ridge vent
- 25 year architectural shingles
- 16" on center roof framing
- R-38 roof insulation
- Dutch lap vinyl siding
- Outside Walls
- 2x6 16" on center sheathed with 7/16 OSB
- R19 wall insulation
- MW Double hung windows with grills
- Window sills

Kitchen/Baths and Cabinets
- 4" counter square Formica backsplash
- Formica brand counter tops
- Richwood light cabinet doors
- Burnished brass pulls on kitchen door
- Cultured marble lavatory sinks
- Oak edge medicine cabinets
- Mirrow, tissue holder, towel bar
- White vinyl coated ventilated shelving

Lighting
- Nutone bath ceiling fan and light
- Triangle vanity lights
- Chandelier
- 2 exterior coach lights on front
- 1 rear exterior light
- Kitchen light
- Decora Switches

ADDITIONAL OPTIONS

- 9' ceilings
- 9/12 storage truss
- 20" overhangs on front of house
- 1" exterior foam insulation
- R-21 exterior wall insulation
- Air infiltration wrap
- 40 year arhetectural shingles
- Oak tread and risers
- Railing package
- Double side lights
- Ceramic tile over ½" concrete board
- Radon vent
- Range circuit
- Washer pan
- Utility sink
- Corian counter tops

Contributors

All Phase Electric
Thompson Lighting
Carriage Carpets
Aristocraft Cabinets
Wolf Distribution
Heister House Millworks
HPI Housing Products, Inc.
Moen Faucets
LaSalle Bristol
Bruce Flooring
Patrick Industries
M&W Windows
Keystone Building Products
Certainteed Siding
IKO Shingles
Seven D Industries
Knauf Insulation
Mariotti Building Products

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WORLDWATER CORPORATION

SOLAR WATER UTILITY

Pumping Systems!

WorldWater AquaMax™ Systems to Drive Two 500 HP and Two 300 HP Well Pumps for Water Utility!

Reduced electric grid usage and "Net Metering" expected to save dollars for 25 years for Joshua Basin Water District in Southern California. AquaMax™ 600 kw solar system will also offset power blackouts and brownouts

Incentives to towns:

50% Utility Rebate

Joshua Basin Water District of Joshua Tree and WorldWater Corp. have opened the California water utility market to new economic savings by using sunshine and the company's proprietary AquaMax™ to:

- Power two 500 hp and two 300 hp well site pumps
- Spin the meter backwards ("Net Metering") when the self-generated solar electricity isn't used in the field
- Save for 25 years!
- Operates during blackouts and brownouts

Southern California Edison, PG&E and all other state electric utilities will "bank" a water utility's unused solar-generated electricity for later use as required by the water utility – AND give 50% of the purchase price of the solar equipment back to the water utility!

All water utilities can benefit from the solar incentives offered.

WorldWater broke the solar power barrier in 2002 by developing and marketing its patented AquaMax™ solar systems capable of operating 600 horsepower water pumps and engines. In addition to this order for two 500 hp and two 300 hp solar water pumping systems, WorldWater is installing a 300 hp refrigeration compressor pump for a California farm and recently installed a 50 hp irrigation system for another California farm. AquaMax™ can operate economically by sunshine alone or in automatic combination with the electric grid or with diesel generators.

Water utilities in California, New Jersey and all over the world now have unprecedented technology available from WorldWater to deliver water to its customers – and increase savings – from sunshine!

WorldWater. The Right Idea at the Right Time.

The mission of WorldWater is to be a leading provider of solar-powered water pumping and electricity for people throughout the world.

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e-mail:pump@worldwater.com
NASDAQ OTC BB: WWAT.OB
A Fully Reporting Company

- Solar Water Pumps
- Solar Electrical Systems
- Water Management

When considered on a worldwide basis, telecommunications provides the lion's share of market opportunities for photovoltaics. Even in the U.S., there is a very large market for telecommunications both in the private sector and among military and government agencies.

Telecommunications applications range from small emergency call boxes to large microwave repeaters, and everything in between. The list of telecom applications grows continuously: relay towers, radio systems, remotely controlled systems, and cellular telephones, to name just a few. These systems range from a few watts to several kilowatts. PV is ideal for communications because the PV-charged battery provides a stable dc voltage and meets varying current demands. PV systems operate reliably—and with little maintenance.

There are thousands of telecommunications systems in use powered either by PV alone or powered by PV in conjunction with another fuel source, such as diesel. These systems, without fail, have proven that PV can increase the reliability and spatial coverage of telecommunications systems of all types.

◁ A solar-powered remote telemetry system provided by Solar Depot, San Rafael, California. This is a common application for photovoltaics. *[Photo courtesy Solar Depot]*

◁ A solar-powered cellular link. *[Photo courtesy Solar Depot]*

◁ Northern Power supplied this TeleSol® PV stand-alone system to Cubic Corporation for a U.S. Air Force Tactical Air Combat Maneuvering and Instrumentation Range located on Nellis Air Force Base outside Las Vegas, Nevada. The sole power source is a 440W solar array comprised of 8 SM55® PV modules supplied by Siemens Solar. Energy produced, if not immediately consumed by the load, is stored in Deka Unigy II series batteries manufactured by East Penn of Lyons, Pennsylvania for this project. The 'brains' of the system is a Northern SC-50 controller. *[Photo courtesy Northern Power Systems]*

On-Site Generation Utilization List

- **Battery Bank Augmentation or Displacement** — Adding length of back-up power to traditional battery banks
- **Battery Charging** (small electronics - lap tops, pdas, computers, walkie-talkies) — Small power (under 100 watts)
- **Building dedicated circuits** for critical functions.

PLUG POWER GenCore Systems

3000 watt turbine ideal for large energy requirements

- Grid-Tie Systems
- Water pumping
- Battery charging
- Science & education projects
- Telecommunications
- Remote monitoring and signaling

AIR Industrial

400 watt turbine designed for harsh environments and extreme wind speeds

- Telecommunications
- Remote monitoring and signaling
- Offshore platforms
- Navigational aids

Windseeker

500 watt turbine that set the standard in reliable wind power

Windseeker

- Remote homes & cabins
- Battery charging
- Science & education projects
- Extreme wind conditions
- Industrial version available

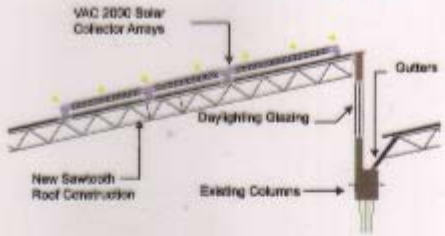
Marine Grade version of our popular Whisper H40 and Whisper H80

Whisper Nautica

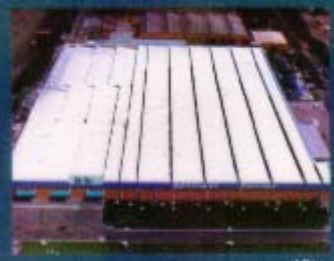
- Offshore beacons or monitoring
- aquaculture and fishing industry
- Seaside remote cabins
- Battery charging
- Science & education projects
- Coastal grid-tie systems

Springer-Carrier Factory

Canoas, Brazil



Before

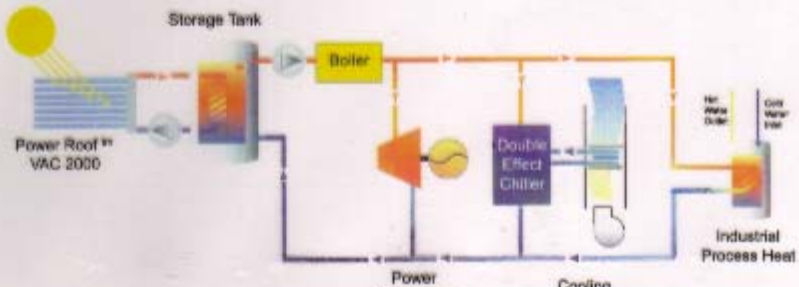


After

Springer-Carrier in Canoas, Brazil, has now completed the first of three phases of renovation that will transition their existing manufacturing operations into the Factory of the Future. In phase I, Duke Solar, working with Carrier's local engineering team, implemented a Power Roof daylighting strategy that resulted in a 30% reduction in cooling load while drastically cutting lighting needs in the 200,000 square foot facility. The Power Roof has already fulfilled several of their major objectives - to increase worker productivity through the use of natural daylighting, reduce cooling costs and minimize lighting costs.

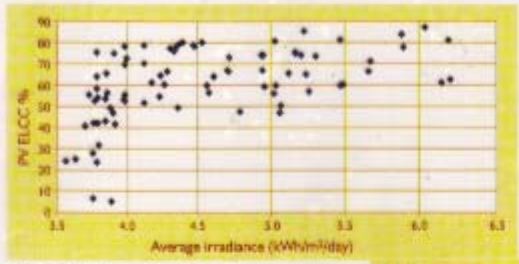
In the next phase, Duke Solar will add VAC 2000 arrays to the sawtooth roof assembly to provide enough thermal energy to not only drive the 700 tons of absorption cooling now installed but to also provide over 200 kilowatts of electricity during peak demand.

The final phase will consist of adding a Power Roof tracking system that will serve as the roof of an addition and provide over 1.5 megawatts of power, enabling the system to meet the total facility's peak load with solar energy.



What Does the ELCC Method Tell Us?

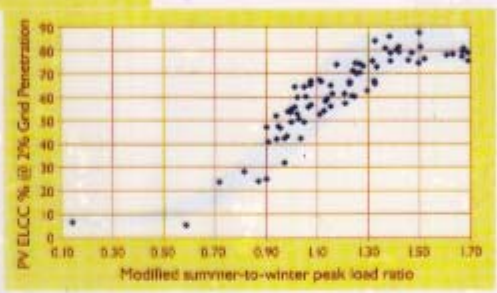
The intensity of the solar resource is obviously critical to PV power generation. But in determining PV's value to a utility, the magnitude of the sun's intensity is less important than its relationship to load requirements.



PV ELCC % vs. solar intensity

The PV ELCC is not related to overall solar energy output.

However, **the PV ELCC is highly correlated with load-shape characteristics.**

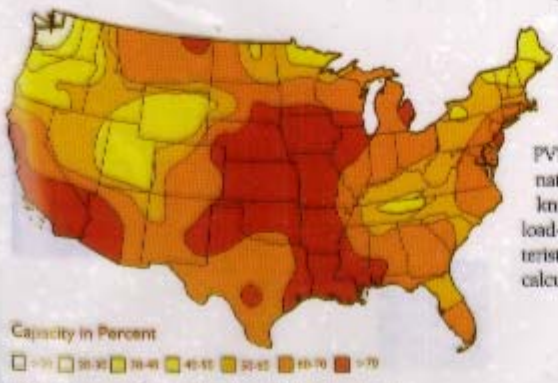


PV ELCC % (at 2% grid penetration) vs. modified SWP ratio

In fact, all utilities studied—whether winter-peaking or highly summer-peaking—fit the pattern that shows PV ELCC increasing as a function of increasing SWP ratio.

ELCC may exceed 80% of the rated PV output when the load is driven by the sun, for example, when the SWP ratio is above 1.5. In that case, a 1-kilowatt PV system would have an ELCC of 800 watts. In other words, a PV system rated at 1 kilowatt could be considered a dispatchable power source of 800 watts.

Can You Picture the ELCC of PV across the United States?



PV ELCC map of U.S. (based on 500 utility loads)

This load-shape relationship provides an analytical tool that allows us to map the distribution of PV's ELCC across the nation. That is, by knowing a utility's load-shape characteristics, we can calculate an SWP ratio and determine an ELCC value for PV. Using SWP ratios from some 500 U.S. utilities, we applied this method to determine the PV ELCC values, which were then plotted, gridded, and contoured to produce the map at left.

To continue to refine this method, we are studying other PV grid-penetration levels, refining the relationship between load shape and PV ELCC, and analyzing multiyear, monthly, and customer trends.

On-Site Generation Utilization List

- Commercial facilities use energy and technologies today that cost-effectively and reliably provide energy on-site. In many cases, these options:
  - Offset high rates,
  - Protect sophisticated equipment from power fluctuations, obviate the need to run wires, lower noise and vibrations, lower emissions and wastes, and most importantly,
  - Assure that functions continue even when the electric power grid or natural gas pipelines may be inoperative.

On-Site Generation Utilization List

- **Lighting** (outside area, motion detector and remote lighting) — Security lighting systems attached to buildings, light poles, or specialized for safety
- **Monitoring and/or Surveillance** (cameras, motion detectors, sensors) — Low power operation — primarily fuel cells, solar and small wind.

ELEVATED SECURITY

On-Site Generation Utilization List

- **Power quality** — dedicated sophisticated controls and digital equipment such as communications and computers that are susceptible to surges, swells and transients from the electric power grid
- **Power Reliability** (communications and computers) — Absolute reliable back-up power for days, weeks or longer

SKYBUILT POWER LLC

- **Remote and Moveable Power Gen Sets** — Using shipping container and pontoons, several systems are "plop and drop" and have quick connectors to add or rotate generation

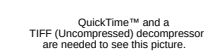
On-Site Generation Utilization List

- **Truck Idling Displacement** — Scaffolding at truck stops or loading points which provide energy and in some cases even cooling/heating, telephone, television and internet access from truck cab
- **Uninterruptible Power System (UPS**) — A portfolio of distributed generation devices which range from 1 kW to 250 kW, on skids, and standardized. Some systems can be leased.

Shell Solar QUICK DEPLOY

On-Site Generation Utilization List

- **Waste Heat from Pipeline Pumps** — Utilization of waste heat from fuel cells, compressor pumps and industrial processes in 55kW or 250 kW increments of electric power
- **Water Pumping and Pipeline Pumps** - and industrial pump back-up or augmentation for controls and SCADA



SOUTHWEST WINDPOWER

Homeland Security
"Critical Infrastructure" Applications
eligible for federally-supported State First Responder Grants

- The following appears to be where applications in clean, distributed energy have been supported by federal and state government programs and the commercial sector, focusing on critical infrastructure hardening for homeland security:
  1. Building and facility back-up power – either whole building or critical circuits for telephone systems, web and wireless communications, space heating and cooling, computing, and lighting, etc. for first responders (police, fire, health), government, and general welfare services (in some cases, private business).
  2. Emergency response (in field) – "drop and plop" generators, on-site powering field phones, computers, and health units, etc.
  3. Low-power protection – cameras, nuclear and biological sensors, perimeter protection including motion detectors, electric fences, lighting, and cameras and sensors.

Homeland Security
"Critical Infrastructure" Applications

4 Infrastructure area support – backing-up critical support services at minimal working levels anticipating prolonged outages: water and sewage pumps, highway signal lights, critical "cold chain" (refrigeration) units for food, vaccine, laboratory testing, and even radio and television services for general population, fuel pumps for transportation fuels, etc.

5 Transportation – lighting, back-up power for signal and safety lights, cameras, gate and toll access control, and communications for highway, port and tunnel, railway, waterway and airports

6. Telecommunications – back-up and prime power for cellular towers and repeaters utility SCADA systems, and remote networks which include telephone switching, field radios and WIFI Federal Programs directed towards States to Leverage Replicable Applications

Federal Programs to Leverage

- Department of Agriculture
  - 9006 Renewable Energy Grant program
  - Rural Utility Service – coops 20 years at 3%
- Department of Defense
  - Federal Energy Management Program (FEMP)
  - Initiatives (funded) including Guardian Program, Facility Portfolio for Emergencies
- Department of Energy
  - STAC program for regional applications
  - Distributed Generation deployment (EE/RE)
- Department of Homeland Security
  - First Responder Grants (primarily police and fire)
  - Critical infrastructure (ports, transportation, airports)
- Environmental Protection Agency
  - State grants
  - Initiatives with State and local governments

What's the goal?

- Leveraging resources
- Replicable installations – sustained orderly development
- Evolve an installation, sales and service infrastructure
- Modularity and standardization – including remote monitoring, diagnostics and controls
- New economic development in the State that can stand on its own feet - *sustainably*

Prepared by Scott Sklar, The Stella Group, Ltd. (2005)