GRID READY PV SYSTEMS

- Better Financial Return
- Unmatched Reliability
- Low Voltage Safety
We are tenKsolar

• PV Solar **System** manufacturer, privately owned and headquartered in Minneapolis, MN

• Leadership:
  – Dr. Dallas Meyer, President – CTO & Founder (formerly Seagate)
  – Joel Cannon, CEO, formerly Cannon Technol. / Cooper Power Systems

• **Idea:** Bring principles from other high reliability semi-conductor industries to address design weaknesses in solar

• **Result:** An elegant, simple PV system, delivering remarkable efficiency and reliability

• **Investors:** Strategic focus, Electric utility (ESB, NRTC), Solar Manufacturer (Hanwha), Energy Infrastructure (Oaktree)
Key Metrics – All Systems:

- **Cost per kWh** – Generate Energy at the Lowest LCOE
- **Energy Density** – Fit More on the Space Available
- **Reliability and O&M** – Redundancy and Reliability Designed In
- **Safety** – Low Voltage, Auto Disconnect

Using Industry Proven, Standard Materials & Processes
System Architecture
Conventional Series Solar Limits Performance

Current flow limited by lowest performing cell on string

High Voltage induces PID losses / arc risks

Modules are uncontrolled energy source

Inverters are single point of failure
tenK RAIS® Low-Voltage, Parallel Architecture

Bus voltage < 60VDC

- Internal panel voltage always < 16VDC = Zero PID
- Redundant Inverters Share Workload Maximizing Uptime
- Modules produce control current output
- Flexibility to size DC & AC Plant as needed

240/277/480VAC
Patented architecture connects cells so shade affects only the shaded area.

Cells are independent and current flows around shade, damage or soiling.

Opens up huge system advantages in design, performance, energy density.

So advanced yet so simple, it makes the idea of a “smart module” obsolete.
Simple, quick assembly on Rooftop

Racking features integrated with module frame

- Pair a module with a reflector or another module create a self-supporting “wave” structure
- Decreases install labor and reduces racking costs
tenK Ground Mount Capabilities

- Driven Pile XTD (1000 kWDC)
- Helical Pile XT28 (120 kWDC)
- Ballasted XT26 (100 kWDC)
AC Plant - Redundant Inverter Bus (RIB)

- 6 - 12 Inverters Grouped Onto One Bus
- Ship Pre-Wired
- Fully Fault Tolerant - Any Module Can Feed Any Inverter
- Integrated Wear Leveling

- Controlled by Vbus - No Digital
- Optimize Efficiency at Low Light
- All Inverters Located at Array Edges
- LED Diagnostics Based
- Multiple Inverter Sources
RIB: Key Benefits

- No Need to Place Pedestal or Pad
- Fully Pre-wired Inverter Bus
- Nests Inside Array
- Pre-Wired AC Disconnect (12-30 kWAC)
Inversion Units All Come On at Different Times
Note: Total Power Curve is Smooth
Also – Repeats AM and PM
Randomized Each Day
Net Required On-Time: 25% vs. 50% For Module Dedicated Inversion
System Configurations
Reflected Wave – Similar Mechanical Features
Use a Low Cost Reflector Rather Than Second Module for WAVE Spectroscopic Reflection Technology (Only Useful Wavelengths)
Result: **Higher kWhAC/kWDC, Energy Density > High Tilt Arrays**
tenKsolar Duo

Very Dense Packing (Best in Industry Density) 15W/ sq. ft.

More Energy to Sell

Lower cost/kWdc

Broader energy profile
DC Plant vs AC Plant

- **DC Plant**
- **AC Plant**

- **Bus voltage < 60VDC**
- **240/277/480VAC**

- **Inverter Capacity (Flexible)**
- **Lower DC/AC Ratio**
- **High DC/AC Rates**

**Strong Sun**

**Weak Sun**

**Time**

**kW**
Addressing Customer Requirements
tenK’s flexible design allows you to optimize for any constraint:

**Space Limited**
Maximum energy density at an industry leading cost.

**AC Limited**
Drive DC ratios as high as you want with no impact on inverters.

**DC Limited**
tenK can use reflection to make more kWh per DC rated watt.

**Shading/Obstructions/Orientation**
Patented RAIS® cell-independent modules allow for flexible layouts.

All tenK solutions set a new safety standard with low-voltage...
Space Constrained Systems
Confined space

To maximize energy generation

- Increase inversion to decrease DC to AC ratio
- Choose lower DC/AC ratio (1.4 to 1.6) to maximize energy (invert as much as you can afford to)
tenKsolar Duo offers More Profit Opportunity

- **tenKsolar Duo**
  - 650 KW DC
  - 762 MWh*
  - 1.47 $/KWh

- **Conventional 310W**
  - 465 KW DC
  - 534 MWh*
  - 1.49 $/KWh

* Energy is average kwh / yr over 25 yr lifetime

Typical NJ Output
AC Power Limited System

To maximize energy generation
- Increase total power output by adding DC
- Choose high DC/AC ratio (1.8 to 2) to maximize energy
Defined DC Limit (MN)

To maximize energy generation

• Use XT-26 or XT 28 (higher yield)
• Choose lower DC/AC ratio (1.2 - 1.4 ) to invert as much as you can
What if the array doesn’t face due south?
Azimuth Sensitivity – XT-26 Reflect

- Yield @ 215 deg (35 deg off azimuth) = 1378 kWhr/kW DC
- Yield @ 180 = 1399 kWhr/kW DC
- Difference = ~ 2.5%

- XT-26 drops 1% @ 20 deg off 180
- Xt-26 drops 5% @ 40 deg off azimuth
Azimuth Graph for XT-26

<table>
<thead>
<tr>
<th>Degree</th>
<th>kWhac/kWDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>50</td>
<td>130</td>
</tr>
<tr>
<td>40</td>
<td>140</td>
</tr>
<tr>
<td>30</td>
<td>150</td>
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<tr>
<td>25</td>
<td>155</td>
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<td>20</td>
<td>160</td>
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<td>15</td>
<td>165</td>
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<td>10</td>
<td>170</td>
</tr>
<tr>
<td>5</td>
<td>175</td>
</tr>
<tr>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td>20</td>
<td>210</td>
</tr>
<tr>
<td>40</td>
<td>220</td>
</tr>
<tr>
<td>50</td>
<td>230</td>
</tr>
<tr>
<td>60</td>
<td>240</td>
</tr>
</tbody>
</table>

Sam, Boston MA TMY3 Class I
Azimuth Sensitivity – XT DUO

- Yield @ 215 deg. (35 deg. off azimuth) = 1188 kWhr/kW DC
- Yield @ 180 = 1198 kWhr/kW DC
- Difference = ~ .08%

- XT-Duo drops .2% @ 40 deg. off azimuth
- XT-Duo drops 2.2% @ 90 deg. off azimuth
### Azimuth graph for XT DUO

#### Walgreens Chelmsford

<table>
<thead>
<tr>
<th>Degree</th>
<th>kWhac/kWDC</th>
<th>104.96 kW DC XT D @ 1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1165</td>
<td>97.90%</td>
</tr>
<tr>
<td>0</td>
<td>1191</td>
<td>100.00%</td>
</tr>
<tr>
<td>90</td>
<td>1165</td>
<td>97.82%</td>
</tr>
</tbody>
</table>

Sam, Boston MA TMY3 Class I

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$kWhAC/kWDC$
216 deg.
104 kW DC
Total 1\textsuperscript{st} year kWhr
  – 124,678 (15% more)

On azimuth build
90 kW DC
Total 1\textsuperscript{st} year kWhr
  – 108,043 kWhr
Harm vs. Ruin
Low Voltage Means Reliability and Safety

The only module in the world with $V_{oc} = J_{sc} = 0$

Arc faults and fires are a real rooftop solar hazard
Impossible with tenK

<table>
<thead>
<tr>
<th>System Component</th>
<th>tenK</th>
<th>SunPower, Suntech, LDK, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cells</td>
<td>Independent in module</td>
<td>Series string – weakest link limits output</td>
</tr>
<tr>
<td>Modules</td>
<td>Each independent</td>
<td>Series string – weakest link limits output</td>
</tr>
<tr>
<td>Modules</td>
<td>Self diagnose in-situ</td>
<td>Must be removed for lab testing</td>
</tr>
<tr>
<td>Inverters</td>
<td>Fully redundant</td>
<td>Single point of failure</td>
</tr>
<tr>
<td>Open Circuit Voltage</td>
<td>0 V</td>
<td>1000 V</td>
</tr>
<tr>
<td>Fault Protection</td>
<td>Each module arc fault detect and GFDI</td>
<td>None</td>
</tr>
<tr>
<td>Max System Voltage</td>
<td>60 V</td>
<td>1000 V</td>
</tr>
</tbody>
</table>
Safety should be #1 concern for large investors

- Every conventional solar array other than tenK has un-fused, high potential
- Avoiding disaster depends on nothing ever going wrong
- Better to engineer the risks out of the system as tenK has done
- Liability risk is by far the most significant risk to commercial system owners
We Offer the Industry’s Strongest Warranty

25 Year System Warranty
- 3% LI Degradation First Year
- 0.2% Degradation thereafter
- 25 years, end-to-end system, inverters, rack, modules. One point of contact
- tenK Warranty Backs 12% More Energy Over Project Lifetime

- Independent Engineering Report Available from Leidos
- Independent Audit Available from SolarBuyer
## Independently Verified Performance Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Time Period</th>
<th>Energy Yield Model Accuracy</th>
<th>TKS vs c-Si</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt. Angel, OR</td>
<td>Aug 2012 – Jan 2014</td>
<td>w/in 2%</td>
<td>18% vs 10° Tilt</td>
</tr>
<tr>
<td>NREL</td>
<td>May 2012 – Apr 2013</td>
<td>w/in 2%</td>
<td>18% vs 40° Tilt</td>
</tr>
<tr>
<td>Leupp, AZ</td>
<td>Nov 2012 – Jan 2014</td>
<td>w/in 1%</td>
<td>27% vs 20° Tilt</td>
</tr>
<tr>
<td>Duke Energy®</td>
<td>Aug 2012 – Jan 2014</td>
<td>w/in 1.5%</td>
<td>21% vs 10° Tilt</td>
</tr>
<tr>
<td>Fraunhofer USA</td>
<td>Aug 2013 – Jan 2014</td>
<td>w/in 2%</td>
<td>19% vs 10° Tilt</td>
</tr>
<tr>
<td>Minneapolis, MN</td>
<td>Aug 2013 – Jan 2014</td>
<td>w/in 1%</td>
<td>15% vs 10° Tilt</td>
</tr>
</tbody>
</table>

**Energy Predictions Accuracy:** Within 2%

**Energy Yield Advantage:** RAIS XN 15% or more over c-Si Low Tilt systems

RAIS XT 15% or more over c-Si Low Tilt Systems
Thank you!

tenK Reflect 275 KW DC Ashburnham, MA
tenK Reflect 26 1 MW DC Frederick, MD
tenK Reflect 26 1 MW DC Polamer, CT
1 MW DC DUO Templeton, MA
Thank You!