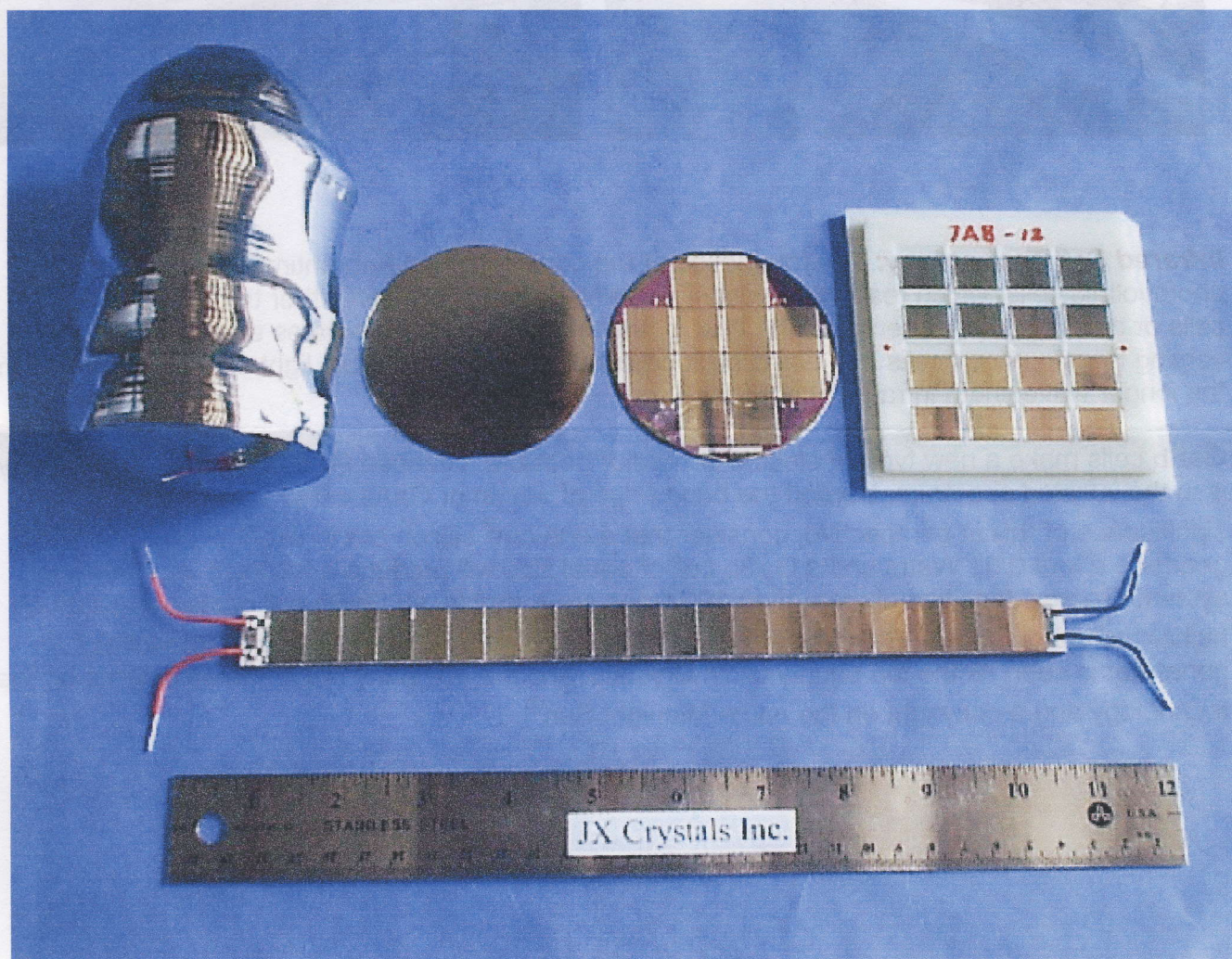




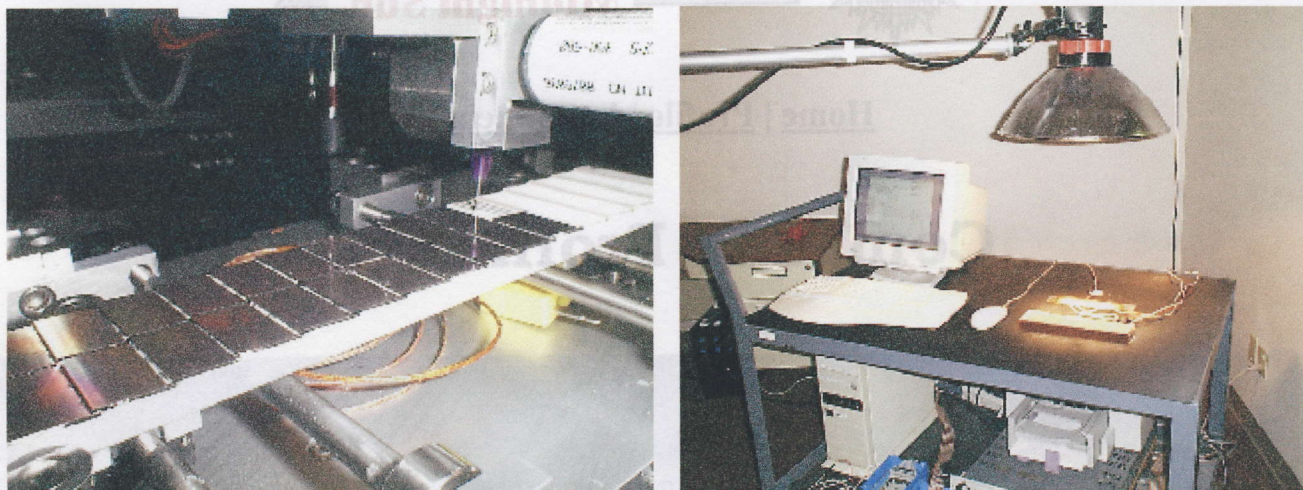
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Company Profile



Photovoltaics without sunlight: JX Crystals manufactures the only affordable photovoltaic cells that respond to infrared radiation from a fuel-fired emitter, rather than the visible light energy from the sun. Using these cells, Midnight Sun[®] cogenerators of electricity and heat are quiet, reliable, clean and efficient, meeting the needs for remote and mobile applications. Military and Department of Energy contracts totaling over one million dollars per year have allowed JX Crystals to fabricate 100 Watt and 800 Watt prototypes and thousands of its patented

infrared-sensitive photovoltaic cells. Pictured above from left to right are an ingot grown, wafers cut and etched, and cells fabricated from these wafers all done at JX Crystals. Six current contracts call for fabrication of units from 20 Watts up to 4 kilowatts.



Infrared Cell Technology: The foundation of the company is gallium antimonide (GaSb) photovoltaic cells, which respond to longer wavelength radiation than either traditional silicon cells or newer gallium arsenide cells. That is, anything which is hot radiates energy in waves of varying length; silicon cells and GaAs cells capture energy in the visible light spectrum, but not in the longer wavelength infrared spectrum.

GaSb cells make a new type of electric generator possible, because 90% of the available energy is in the infrared spectrum, beyond the band edge of silicon or GaAs cells. To put the significance of this in perspective, consider that a one cm^2 silicon cell in direct sunlight will generate about 0.01 Watts and a GaSb cell of equal size will produce a full Watt in a fuel-fired system. Energy densities of more than 100 times are possible, so GaSb cell costs can be much higher than silicon costs. Development of the first commercially viable "thermophotovoltaic" generator is seen as the top priority of JX Crystals, and the company holds twelve patents on the technology and a copyright on the name Midnight Sun[®].

JX Crystals Inc.

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First Product - The Midnight Sun® Heating Stove: The first practical Midnight Sun® generator is a simple propane-fired heating stove that puts out 25,000 Btu/hr of heat and simultaneously generates 100 Watts of electricity. GaSb cells are lined up along a special emitter in the stove's burner, so the fuel is already burned for heat and the electricity to charge batteries is "free". The unit is a natural complement to solar systems currently used in the off-grid cabin market; battery systems are already in place and solar panels are typically inoperable when the heating stove is most likely to be used.

Off-site testing will begin in January of 1999, with 30 beta site test units. Sales are projected to grow from 1,000 units in the 99 season to 2,000 and then to 4,000 in 2001. Retrofit and water heater systems also have strong potential.

Positioning the Company: A critical accomplishment of the strategy of pursuing the heating stove product first is the market potential that it will create. Volume production of cells to meet the needs of the niche market for off-grid heating stoves will drive down cell costs and create several exciting and much larger opportunities.

Larger Markets - Self-Powered On-Grid Furnace: In the year 2000, JX Crystals intends to

enter the self-powered appliance market. This is a triple-sized version of the heating stove unit, but the generated electricity is used to power the blowers on a conventional home furnace. The application of this unit is far more widespread than the heating stove unit, because users are fuel-fired furnace owners willing to pay a \$500 premium for a furnace that continues to operate when the electric power fails. The energy saved because the blowers are not drawing from the electric utility actually pays for the unit over the course of five to ten years, but the primary market is furnace owners that have suffered long interruptions or consider themselves likely to face such a prospect. We believe that as much as half of the residential furnace market would be interested in such a product.

Forging Relationships: The company's expertise is in GaSb cell development, but GaSb cells only have value if applications are developed. While JX Crystals is developing these applications itself and sees tremendous potential in manufacturing the end products, it remains open to partnership agreements that would speed development. [Partnership arrangements are forming on several fronts.](#) For larger scale commercial applications, there has been strong interest from furnace companies.

Meeting Residential Needs: By the year 2002, we expect to go public in order to build a power circuit production facility with a 100 megawatt production capacity. This facility will be used to supply power circuits for the rapidly expanding self-powered furnace business. Power circuit prices at this production volume will be low enough to enter the co-generator market in colder climates at prices where the furnace in the garage can be replaced with a multi-kilowatt Midnight Sun[®] co-generator unit. This system will heat the home and generate enough electricity to power the home at rates competitive with the electric power grid. The driving force for micro-cogenerators will be fuel efficiency. While the fuel to electric efficiency in a central power plant may be 30%, 70% of the fuel energy is wasted. Meanwhile, a micro-cogenerator will use 90% of the fuel energy for on-site heat and electricity. Since our special infrared cells generate one hundred times more power per unit area than solar cells, our 100 MW plant will be similar to a small 1 MW solar cell production facility.

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Direct all website related question and comments to jxcrystals@jxcrystals.com



This page was designed by W. Mitchell Groeneveld

