



# MONO CRYSTALLINE SOLAR PHOTOVOLTAIC MODULE PRICING COMPARISON (US, EUROPE, ASIA & BANGLADESH)

GreenTek Energy Research USA, Inc

## Summary of Mono Crystalline Solar PV Module Pricing for 2009 To 2015 November 2009

Submitted To:  
<Confidential Company Name>  
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Dhaka, Bangladesh

Submitted BY  
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November 17, 2009

Managing Director  
<Confidential Company Name>  
<Confidential Address>  
Dhaka, Bangladesh  
Attn: <Confidential Name>

Dear Sir/Madam,

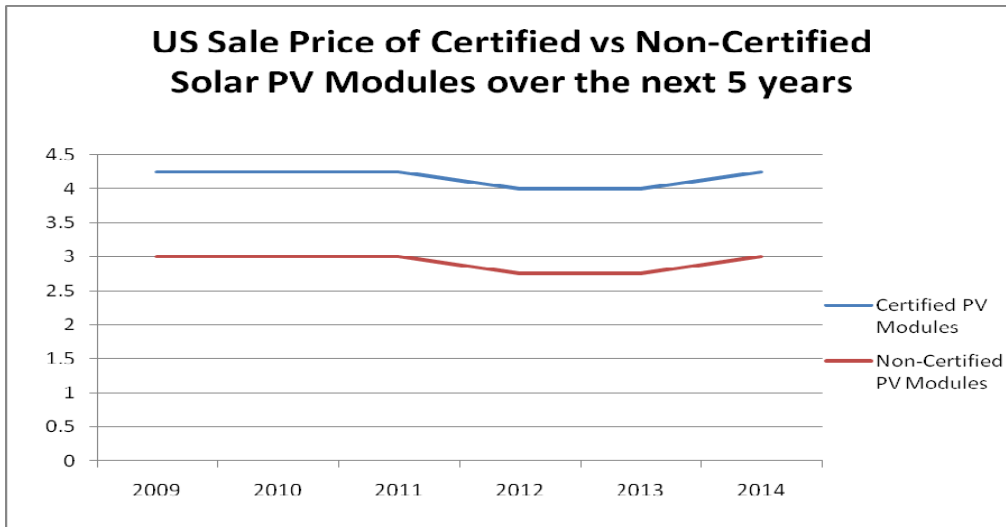
As per request from <Confidential Company Name> for a detailed cost analysis of mono-crystalline solar PV modules in the current and future wholesales market, GreenTek Energy USA Inc. has done an extensive research and gathered the information in this "Summary of Projection for PV Module Pricing."

RTSP's vision is to become the global leader in manufacturing mono crystalline PV module of high quality, internationally recognized certified, labor cost effective, 17%+ above cell efficiency, durable, better cell output, higher wattage, low sunlight functionality, reliable, grid-competitive green electricity starting with imports to US and Europe retailers that do not accept cheap quality products. Undoubtedly producing solar PV modules using State of the art hi-tech turnkey production line using renowned equipment from U.S. will accompany the guarantee of the modules being certified in a facility certified to ISO 9000/9001/9004/19011:2000 quality and ISO 140000 14001:2004. These optimally enhanced panels come with 25 year warranty which is very high in terms of product life cycle and this will attract residential and commercial customers both US, EU and local markets. These solar PV modules will be much superior to cheaper Asian products available now.

According to international solar industry, American Association of Solar Energy and other recent research done on pricing for comparative price analysis, the quality certified (UL, IEC) modules are now being sold in US and EU market at average price of \$4.25/watt in the US and EU and the non-certified panels are sold at \$3.00/watt. The same products are now imported by Bangladesh retailer like Rural Electric Foundation of Rahim Afroz, Grameen Shakti from Japan and China and sold at an average wholesale price higher than the cost to manufacture better solar PV modules by RTSP, yielding RTSP to have a higher margin of profit. The price trend for the next 5 years is forecasted in the following table:

	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
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<b>UL Certified Panels</b>	\$4.25	\$4.25	\$4.25	\$4.00	\$4.00	\$4.25
<b>Non/Lower UL Certified Panels</b>	\$3.00	\$3.00	\$3.00	\$2.75	\$2.75	\$3.00



Since the solar PV module manufacture will saturate around 2011, there may be solar panels in excess in the market. So there will be a slight reduction in sale price but as soon as the inventory is pushed out with simultaneous reduction in production, there will be a higher demand and shorter supply by mid 2013, hence sale price will increase. These mono-crystalline solar PV modules are quite robust and reliable with advanced chemical composition, hence price degradation of these panels is not foreseen until at least 5 years.

Please feel free to contact us if you have any question on the comparative

Sincerely,

Md Jamil Uddin, President

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The imminent global energy crisis arises not only from shrinking reserves of fossil fuels and the public concern of global warming, but also from ageing nuclear power plants which are going to cease operation in near future. There is a global realization that fossil fuel usage must be reduced drastically in order to arrest green house gas (mainly CO<sub>2</sub>) emission to the atmosphere, which causes global warming. In fact, this aspect of global warming, rather than the looming shortage of fossil fuel that is propelling all industrialized countries, in the West as well as in the East, into taking urgent actions now. Commercial nuclear power all over the world is undergoing an unprecedented revival. But some countries, such as Germany, Italy and few others, are reluctant to jump into the nuclear bandwagon and, instead, concentrating on research and development of alternative or renewable sources of energy, particularly the solar energy.



Figure 1. Global growth of Solar Power from 2000 to 2008

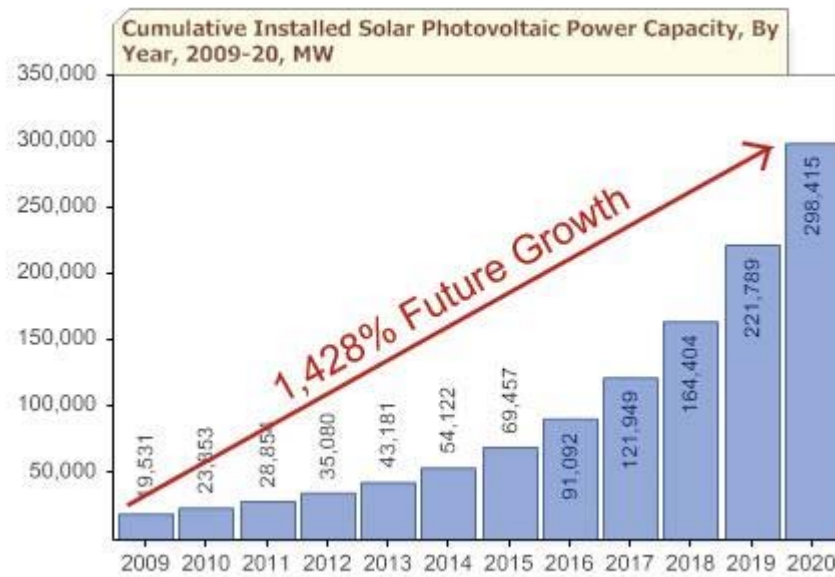


Figure 2. Forecasted Global growth of Solar Power from 2009 to 2020

### **Current Market Demand in US**

Affordable solar power is no longer a vision for the future, it's very much here now, ready to be a significant part of US energy mix. This means there has never been a better time for energy customers to go solar or for the government leaders to invest in building a new solar economy.

- Solar Energy demand has grown at about 30% per annum over the past 15 years (hydrocarbon energy demand typically grows between 0-2% per annum).
- The US market grew to 357 megawatts in 2008. Japan's market is now the sixth largest market. Spain was the largest market in 2008.

The demand for photovoltaic (PV) modules in the U.S. is expected to more than triple from 2005 levels in 2010 with shipments of PV modules equaling 531 megawatts (MW) of generating capacity, and \$1.3 billion in revenue according to a recent study by the Freedonia Group, a Cleveland-based market research firm.

The report finds that the growing demand for PV products will be driven by the falling price of solar power, which stems from technological innovations, growing economies of scale and a rising level of government tax incentives and rebates at both the state and federal levels. Note that this drop in price will not apply to the technologically advanced solar PV modules produced by RTSP. Gains will also be spurred by consumer interest in renewable energy sources and concern about the volatility of oil and other conventional energy prices and supplies.

	YEAR 2000	YEAR 2005	YEAR 2010	Percentage Annual Growth, 2005-2010
<b>PV Module Demand (million dollars)</b>	106.8	526.0	1275.0	19.4

Table 1. Forecast of PV Module Demand in the US (courtesy of The Freedonia Group)

### **Current Market Demand in Europe**

Germany was the fastest growing major PV market in the world from 2006 to 2007. By 2008, 5.337 GWp of PV was installed, or 35% of the world total.

In 2002, the world production of photovoltaic modules surpassed 550 MW, of which more than the 50% was produced in the EU. At the end of 2004, 79% of all European capacity was in Germany, where 794 MWp had been installed. The European Commission anticipates that Germany may have installed around 4,500 MWp by 2010.

### **US and Europe Mono-Crystalline Solar Module Pricing**

Solar Energy (photovoltaic) prices have declined on average 4% per annum over the past 15 years. Progressive increase in conversion efficiencies and manufacturing economies of scale are the underlying drivers. A residential solar energy system typically costs about \$8-10 per Watt. Where government incentive programs exist, together with lower prices secured through volume purchases, installed costs as low as \$3-4 watt - or some 10-12 cents per kilowatt hour can be achieved. Without incentive programs, solar energy costs (in an average sunny climate) range between 22-40 cents/kWh for very large PV systems.

So after a spell of rapid declines in retail prices that first showed up in this survey in February of this year, this month's result displays the lowest number of price moves since July 2008. The trend though is still downward, but at nothing like the pace we have seen in recent months.

Dramatically falling prices in 2009 will impact major players; high efficiency mono-crystalline and low-cost thin-film technologies will have a 30 percent efficiency-adjusted cost advantage over traditional multi-crystalline producers, leaving them well-positioned to survive the impending shakeout.

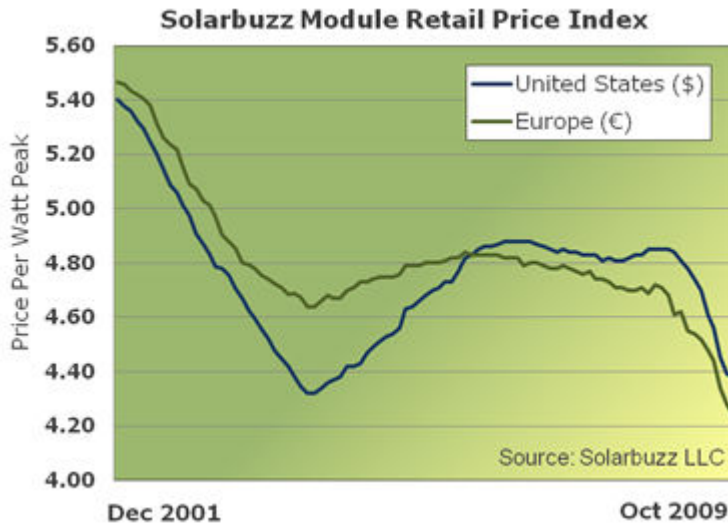


Figure 3. US and Europe Retail Price Index from December 2001-October 2009

The tracking of the lowest price band in the survey is measured against the number of prices below \$4.75/watt. Prices much higher than this are typically most associated with module powers below 125 watt. As of October 2009, there are currently 536 solar module prices below \$4.75 per watt (€3.23 per watt) or 37.3% of the total survey. Coincidentally, this number of price points is identical to the number in September 2009. Being conservative, if the margin of selling price is lowered and rounded down to \$4.25/watt to match the downward trend of selling price in the next 6 months.

**Average US/Europe Wholesale Selling price- \$4.25/watt (Quality Certified)**

The lowest wholesale price for a mono-crystalline silicon module is also \$2.50 per watt (€1.70 per watt), from an Asian (Chinese) retailer.

**Zhejiang Solar Best Energy Technology Co., Ltd., China- \$2.50/watt (Non/Lower Quality**

**Certified)**

**Maharashi Solar Technology, India- \$2.80/watt (Non/Lower Quality Certified)**

Note, however, that "not all models are equal." In other words, brand, technical attributes and certifications do matter. Once again, that these prices are based upon the purchase of a single solar module and prices are exclusive of sales taxes.

### **Other known Brand Wholesale price in US Market:**

Sharp, US - \$3.14/watt in wholesale price

GE Solar, US-\$7.12/watt

SolarWorld, US-\$4.04/watt

SunWize Solar, US- \$4.14/watt

### **Current Market Demand in Bangladesh**

Only 35% of the total population is under power supply coverage. Yet national production and delivery hardly meets about 60% of the suppressed national demand. DESA and DESCO demand more than 1,800MW, while the Rural Electrification Board (REB) seeks 2,200MW and PDB itself needs another 1,500MW. This means that the real load-shedding is around 2,200MW. The PDB officially puts the present demand at 4,400MW. If there was no gas supply problem, PDB could have ensured up to 4,200MW power and minimize the crisis by handling only 200MW load-shedding.

Bangladesh is facing an acute shortage of energy. The present capacity-limited gas production cannot simultaneously meet both domestic gas requirements and support electricity generation for domestic and industrial purposes. The rationing of gas supply to the fertilizer factories is going to affect the agricultural output. With load shedding across the country, industrial sector is adversely affected, with the consequence of reduced volume of industrial output and diminished export earnings.

Only 35 per cent of the population is somehow covered by electric supply through national grid. Even with such lower percentage coverage, the national power requirement is around 6000MW; whereas present generation capacity is only 3,800MW. This shortfall necessitates load shedding. Moreover, many of the power generating plants have outlived their original design lives and may cease operation at any time, with the consequence of aggravating national energy scene even further.

The Power Division of the Ministry of Power, Energy and Mineral Resources of Bangladesh on 15 September 2009 had depicted a gloomy picture of country's energy situation and advocated urgent actions. The Power Division had also proposed that no gas supply should be given to gas-fired power plants after 2012, in order to conserve diminishing gas reserve for domestic use only. To remedy the situation, the country has negotiated a deal with India to import 100 MW of power (Energy Bangla, 10 September,

2009). The Government has also negotiated with private companies renting power plants on a temporary basis and buying power at higher rates. The whole situation borders on national energy crisis management.

Solar Energy demand in BD is 100 MW and will grow to 800 MW by 2020 since BD Government is encouraging PV installation and growth to curb the power crisis.

## **Bangladesh Mono-Crystalline Solar Module Pricing**

### Existing Vendors

**Butterfly (LG – China) - TK 45000 ~ \$5.35/watt (in 2009)**

**Rural Service Foundation (Rohim Afroz – Kyocera) – TK 22,600 ~ \$2.70/watt (in 2009)**

### RTSP Proposed cost of production of Mono-Crystalline Solar PV modules in Bangladesh

#### **RTSP- \$1.90/Watt Production Cost**

Cell	\$1.30/watt
Glass, lamination & other process materials	\$0.40/watt
Labor	\$0.10
Miscellaneous	\$0.10
<b>TOTAL</b>	<b>\$1.90</b>

#### **Proposed Wholesale price per watt for RTSP PV Module in Jan 2011**

**1) \$3.00/watt wholesale price for Non/Lower Quality certified Panels**

**2) \$4.25/Watt Wholesale price for Quality Certified in US-EU market**

**Comparative Cost Analysis of Manufacturing vs. Purchasing 40,000 Mono-crystalline Solar PV Modules**

	<b>Bangladesh</b>	<b>Bangladesh</b>	<b>China</b>	<b>Remarks</b>
	Manufacture by RTSP (Quality Certified PV Modules)	Purchase from Rohim Afroz (LG) (Non/Lower Quality Certified PV Modules)	Purchase from Zhejiang Solar (Non/Lower-Certified PV Modules)	
Price/watt	\$1.90/watt	\$2.70/watt	\$2.50/watt	
Processing 40,000 modules per year each avg. ( 200 watt)	\$15,200,000	\$21,600,000	\$20,000,000	
Projected Sales in US/UK Market for 2010 to 2015	\$34,000,000  (Quality Certified PV Modules on avg. sell for \$4.25 in US/UK)	\$24,000,000  (Non/Lower Quality Certified PV Modules on avg. sell for \$3.00 in US/UK)	\$24,000,000  (Non/Lower Quality Certified PV Modules on avg. sell for \$3.00 in US/UK)	RTSP panels will be UL and IEC certified, thus will have higher sale price
Net Difference	\$18,800,000	\$2,400,000	\$4,000,000	
<b>Profit</b>	<b>123.68%</b>	<b>11.11%</b>	<b>20%</b>	

## **Conclusion**

One can be sure that the recent reduction in solar electricity prices has stimulated demand around the world. Two billion people in the world have no access to electricity. For most of them, solar photovoltaic would be their cheapest electricity source, but they cannot afford it. Asia will constitute 82 percent of global crystalline silicon cells by 2012. The dramatic ramp in production will drive costs down for Asian producers, giving them a significant edge over established European players who will lag behind in expanding manufacturing capacity.

Solar energy promises to be a major source of energy in Bangladesh. Rapid industrialization, urbanization, high population growth, increased food production; rising standards of living etc all place unrelenting demand on the energy sector. On the supply side, gas reserve in Bangladesh is rapidly shrinking and most of the existing power plants are beyond their design lifetimes.

At this juncture of energy shortage, solar energy can play a vital role. Use of solar energy does not require high technology and technical know-how and it can be used by wider population in remote villages. On top of it, it is risk free and mainly maintenance free and durable.

Solar energy is beneficial to Bangladesh not only on environmental grounds but also on pure economic grounds. But before this energy takes off in Bangladesh in a large scale, national government and/or international organizations must provide stimulus and grants to companies involved in spearheading its use.

As solar business is in its infancy, RTSP should capture this opportunity and become a major world player in this multi-billion dollar business by manufacturing high-quality, cost effective mono-crystalline solar PV (Photovoltaic) modules and hence export to US and Europe for a prosperous and environmentally friendly business.