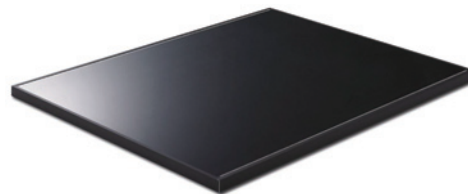


## Solar Frontier CIS Thin-Film Solar Panels

### Features

- ◆ CIS (denoting main ingredients copper, indium, selenium) thin-film modules produced using Solar Frontier's proprietary technology
- ◆ 8% higher annual electrical output than crystalline silicon modules
- ◆ Ecological – no silicon or cadmium, low energy consumption in production
- ◆ Quality – 20 years in development and a 20 year warranty
- ◆ Design – Good Design Award, Ecology Design Award (2007)
- ◆ Produced at Japan's largest solar module production facility, and the largest CIS factory in the world. Operating since February 2011, Kunitomi Plant delivers cost competitiveness through scale and economy.

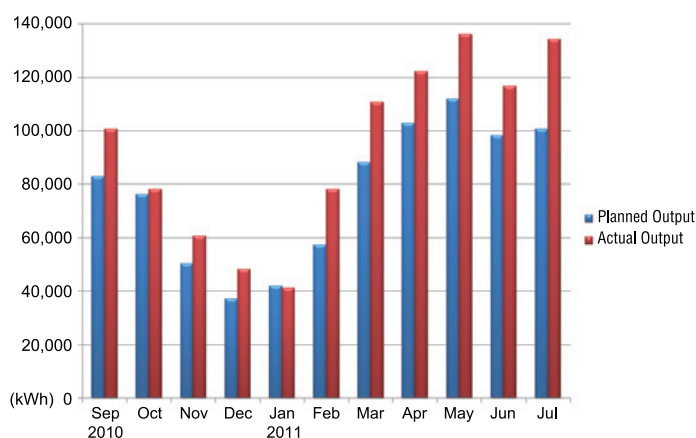
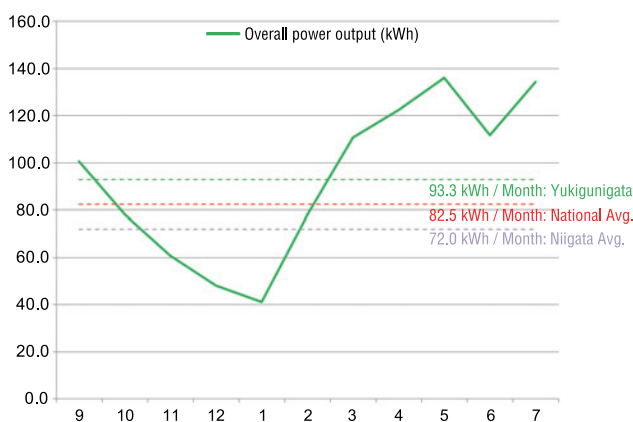


### Basic Concept or Summary

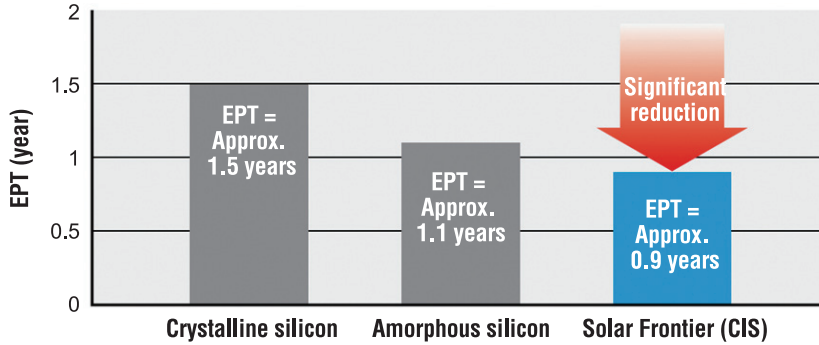
- ◆ Solar Frontier's CIS modules soak up a wider spectrum of light than conventional crystalline silicon
- ◆ A lower temperature coefficient means more kWh produced under hot conditions
- ◆ Modules continue to produce electricity even when partially covered by shadow
- ◆ "Light soaking" effect increases output from the initial rated value by up to 10% (based on tests by Solar Frontier)

### Niigata Yukigunigata Megasolar Power Plant

Solar Frontier's CIS solar modules generate high power output even in cloudy and snowy conditions such as those found in Niigata, Japan. From September, 2010 to July, 2011, the CIS modules installed at the plant delivered 20% higher output than initially forecast. Annual electricity output per kW is expected to be 1,100 kWh, surpassing the national average of 990.02kWh per year. This is thanks to CIS characteristics –delivering high output in hot conditions, and a frame flush with the module's glass, meaning snow slips off easily.



- ◆ Simpler production process delivers consistency and lower energy consumption
- ◆ CIS coating, at 2-3µm thin, is 100 times thinner than silicon modules, meaning less raw materials needed
- ◆ Energy payback time of less than one year (energy payback time = the time it takes to generate the amount of energy it took to manufacture the module)
- ◆ Solar Frontier modules have no special recycling requirements.



**Installation in Practice or Schedule**

**Installation Record**

Solar Frontier started operations at its Kunitomi Plant, Japan's largest solar module production facility, and the largest CIS factory in the world, in February, 2011. The plant will have an annual output of 900 MW, and 30% of this will be sold in Japan, 70% in the rest of the world. Mass-production of these high-performance CIS modules means Solar Frontier is supplying new demand for affordable solar panel performance in the residential, commercial and utility-scale markets around the world.

**Examples of introduction**



Japan installation



Gunkul Powergen utility-scale power plant in Thailand

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