

# Quantum Jump: An Oncoming Energy Revolution



*To take the oceans none had sailed before  
towards a low-cost zero-emission future*

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Harbinger of A Brand New Era

# Executive Summary

The world is growing like never before. Growth demands more energy, while at the same time, less carbon emission is a necessity. This is a dual challenge that everyone is facing, and its solution is calling for the advent of a breakthrough energy technology.

## what is the problem?

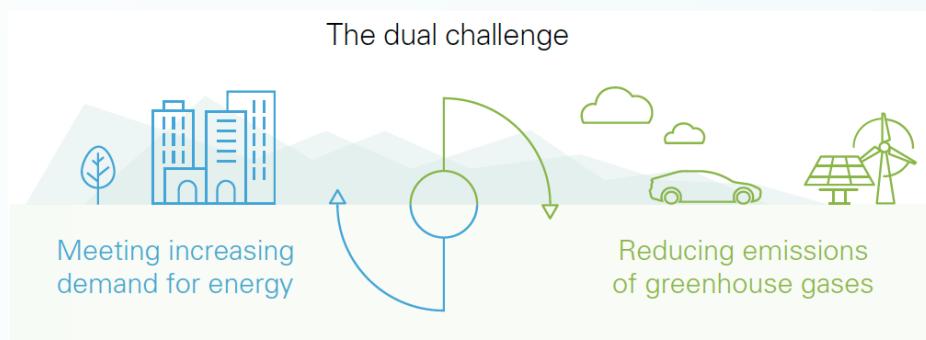


Image Credit: BP Technology Outlook 2018

Solar power has been viewed as one of the most prospective answers to this dual challenge. However, current solar power products are expensive and intermittent. People are trying to make up for those disadvantages via increasing the *peak* power of solar cells, or combining it with other power sources. After so many years' government subsidy towards traditional solar power projects, it is time to ask, is that really the correct direction for a feasible solution?

## what we do?

Based on our team's vision on the demand for energy of an industrialized society, we are determined to accept this supply-side challenge.

Although peak power might be an important indicator for solar cells, we think that the baseline power output is much more crucial.

Now, after years of research, experimentation, and prototyping, we are proud to present quantum light concentration technology as a revolutionary solution to the dual challenge.

## Our missions

### Low-cost and all-weather electricity generation

- Much more electricity output
- Better electricity quality
- Incredibly lower module price
- Customizable multi-functional components
- Significantly lower overall carbon emission

### Truly distributed electricity generation

- Instead of requiring direct sunlight, we manipulate photons to cater to the taste of solar cells
- Electricity can be generated everywhere you wish, as photons are omnipresent during the daytime
- No more need to direct the panel towards the sun like a sunflower

At a price lower than fossil fuel power generation, quantum light concentration technology provides electricity with zero carbon emission during the generation period, and far more stable output compared to traditional solar power.

Let us take a closer look at this magic, and peeking at how it energize and inspire other industries to create an exciting new world.

# Major Drawbacks of Solar Power

The original application of solar cells belongs to satellites in the space, starting from 1950s. Where budgets are abundant and dazzling sunlight is persistent during the daytime.

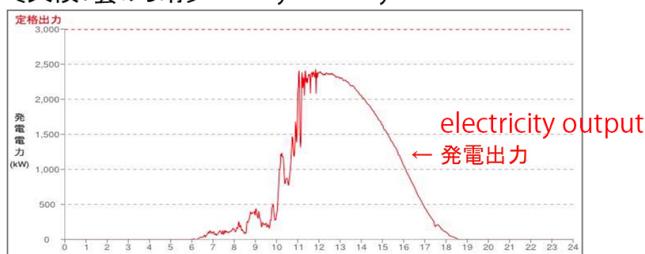
Unfortunately, shining and stable natural illumination can never be guaranteed when it goes to terrestrial applications.

Hence the following two problems have been overshadowing the applications of solar power on land since its birth:

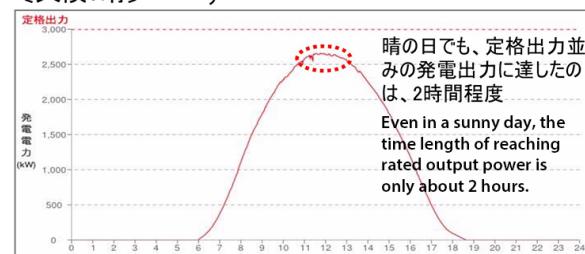
- Strongly weather-dependent output
- Expensive electricity generation cost and associated implicit cost

Electricity generation records by weather (spring) of mega-solar power plant in Omuta (output: 3000 kW)

〔天候:曇のち晴〕 cloudy to sunny



〔天候:晴〕 sunny



〔天候:曇のち雨〕 cloudy to rainy



〔天候:晴ときどき曇〕 partly cloudy



【メガソーラー大牟田発電所(出力3,000kW)の天候毎の発電実績(春季)】

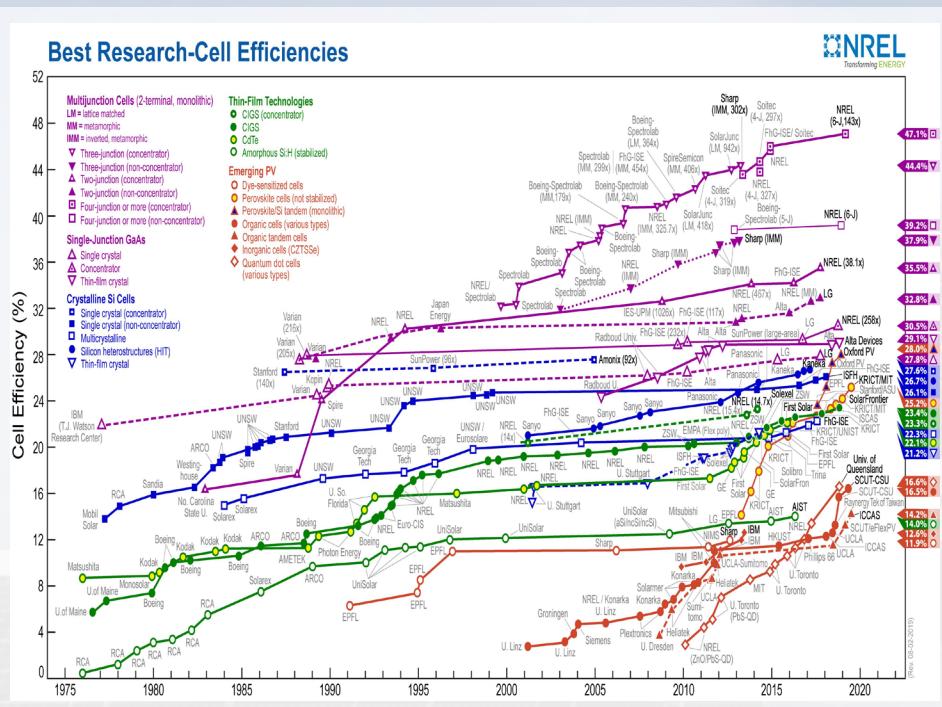
九州電力データブック2018

Most research aiming at reducing the cost of solar power have been focusing on raising the peak power efficiency, in the hope that more electricity generation when direct sunlight is present can compensate for the lack of electricity generation during cloudy and rainy times.

However, that actually makes electricity more unstable, as a consequence, implicit cost could become higher.

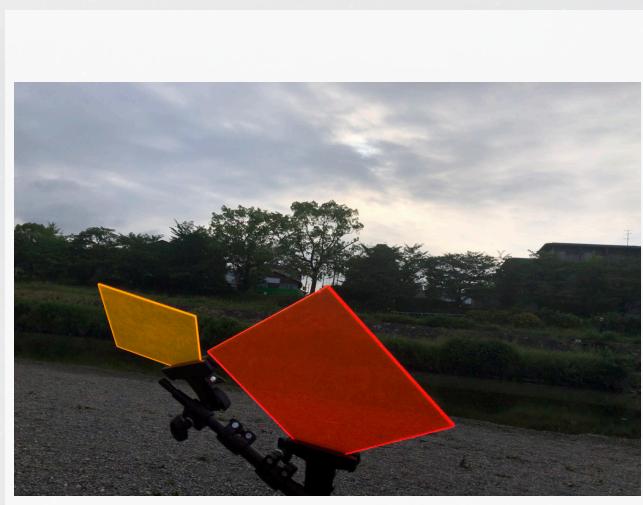
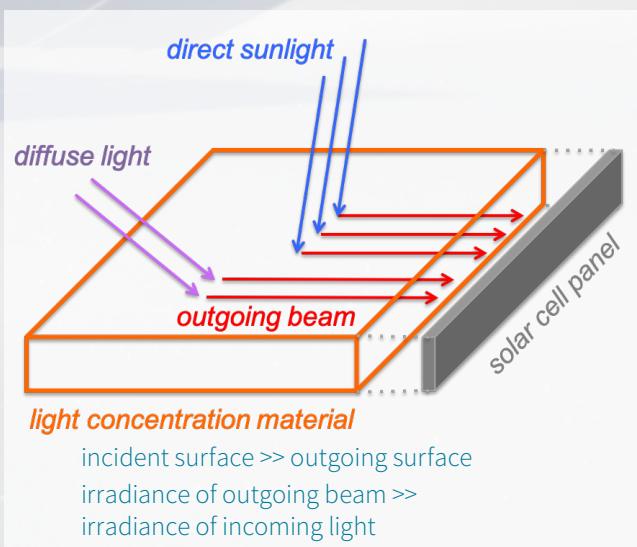
The diagram to the right shows efficiencies of the best solar cells you can find in this world. To realize such high efficiency, their cost can be very high (for the usage of rare-earth elements). In particular, the efficiency is measured under the standard test conditions, which only last for a few hours even during a sunny day.

Raising the peak power efficiency is a legacy ideology coming from the research of solar cells for satellites. But for terrestrial application, after following this way for so many years, we shall put a question mark on whether it can lead us to a satisfactory solution.



A brand new idea and technology is needed here. To create a solar cell that can output stably even if the sun is overcasted, instead of keeping on tailoring the materials to the taste of sun spectrum, we shall intervene in the affairs between photons received and the solar cell. The answer to an all-weather solar cell is:

**concentrate and manipulate photons,  
and keep providing bright enough illumination for solar cells**



Notice that edges of the two panels are glowing

# Quantum Light Concentration Technology

Quantum light concentration technology is a fundamental technology that can selectively (according to a photon's wavelength)

- align the directions of incident light with different angles to realize concentration
- change the wavelength of light, make it more suitable for solar cells

Instead of reinventing another new solar cell with higher efficiency in the laboratory, this technology can always leverage on the most advanced solar cell by keeping providing brighter light.

Furthermore, we can protect the fragile solar cell and help avoid the hot spot heating effect By reducing the amount of ultra-violet light and providing uniform light output.

In terms of the output of electricity, there are two distinct advantages:

- more electricity generation, all-weather
- better electricity quality

and everything else (conversion, transmission and distribution of electricity) remains invariant as usual.

Above all, it is *extremely inexpensive*.

## Methods, indicators, and features

During the daytime, we can approximate the power of electricity generated by a solar cell using the formula below:

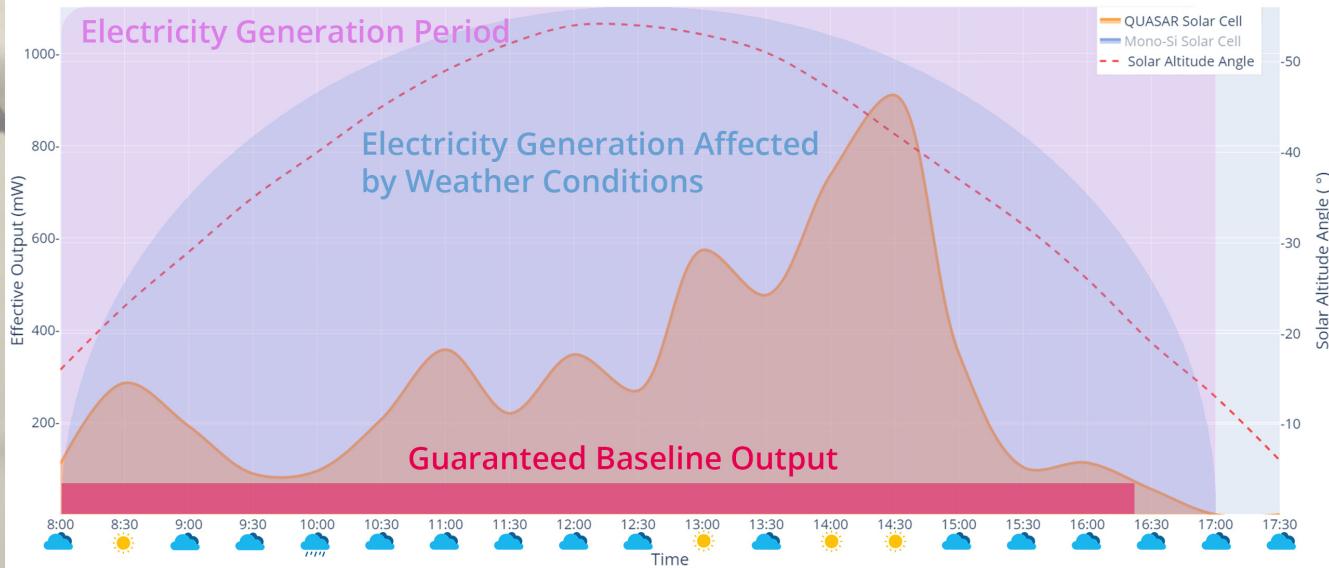
$$\text{Power} = a + R(\text{weather})$$

Where  $a$  is a constant determined by latitude, and insensitive to weather and orientation. It measures the guaranteed baseline electricity output, higher value implies more stable output.  $R(\text{weather})$  is the output highly related to local weather.

For all market solar cells,  $a = 0 \text{ W}$ , and  $R(\text{overcast}) = 0 \text{ W}$ . In order to provide stable output, we shall try to increase  $a$  in this formula. See the following two diagrams for a comparison between QUASAR's solar cell and monocrystalline solar cell.

## QUASAR Solar Cell

Effective Output (05/Nov/2018 Haikou, China, Overcast with Showers)

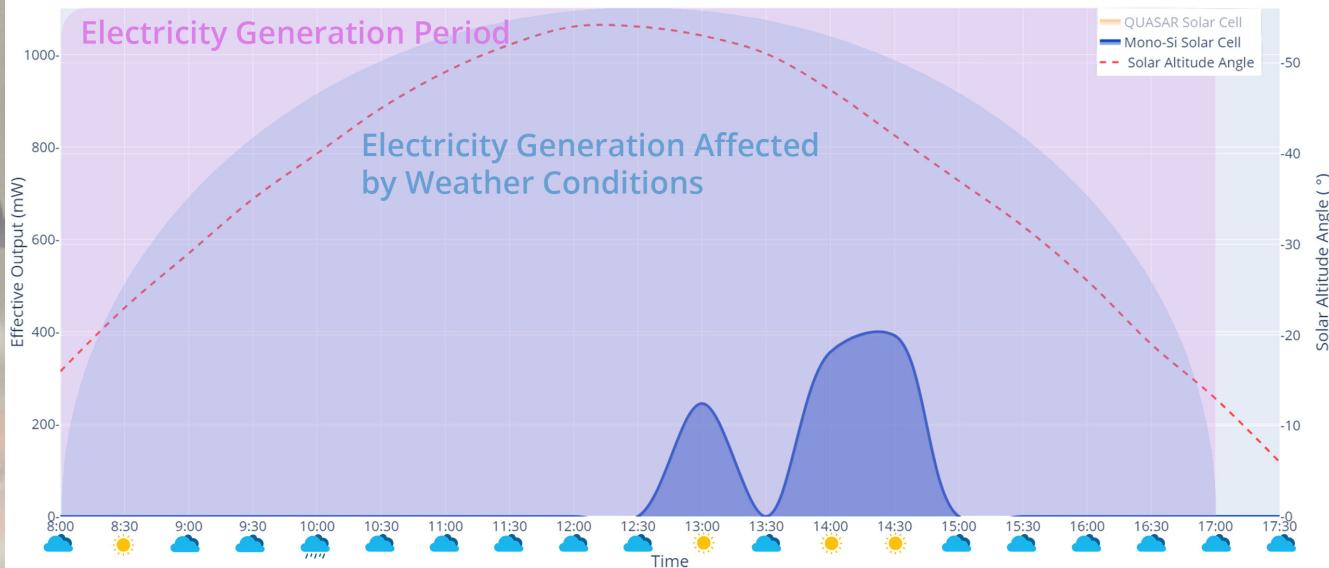


Output is counted as effective if the open-circuit voltage is at least 85% of the rated output voltage. From the diagram below, we see that the output of the mono-Si solar cell is highly affected by clouds, which is highly random.

Quantum light concentration technology smoothes this randomness by concentrating diffracted light. Thus we are able to provide reliable guaranteed baseline output.

## Mono-Si Solar Cell

Effective Output (05/Nov/2018 Haikou, China, Overcast with Showers)



## Comparison

Comparison of Philosophies	
Baseline Power First	Peak Power First
<b>Product</b>	
Quantum light concentration technology powered solar panel	Mono-Si/ multi-Si/ thin-film solar cell
<b>Specification</b>	
<b>Effective electricity generation period</b>	
Environment irradiance $\geq 100 \text{ W/m}^2$	Only when a midday sun is available
<b>Stochasticity</b>	
Reliably planable output	Highly unpredictable, affected by clouds
<b>Orientation of panels</b>	
General position allowed	Towards the sun during the noon or solar trackers needed
<b>Application Scenarios</b>	
Multi-functional and customizable	Limited, restricted by cost and orientation
<b>Solitary Power Source?</b>	
Yes	No

## Baseline Output

Powered by quantum light concentration technology, QUASAR's product demonstrates an amazing all-weather electricity generation constant  $a = 9 \text{ W}^1$ . In addition, we can change the value of this baseline output according to client's need (up to 36W, at this point of time).

See a video of an electric fan powered by QUASAR's product in the shade: [link<sup>2</sup>](https://www.quasar.solar/demo_fan.html).

1. environmental irradiance  $\geq 100 \text{ W/m}^2$
2. [https://www.quasar.solar/demo\\_fan.html](https://www.quasar.solar/demo_fan.html)

## Stable Output

As electricity generation is guaranteed regardless of the weather, this product alone can:

- provide schedulable and reliable output, for industry-level users
- be the primary power source, not only a complementary one
- be the only power source, combined with batteries for night-time usage

## Performance Comparison

**Efficiency @ 1000 W/m<sup>2</sup>(standard test conditions)**

**21.7% vs. 23.9%**

**Quasar solar cell    Mono-Si solar cell**

Achieving comparable efficiency using only half of the total mono-Si solar cell.

**Efficiency @ 100 W/m<sup>2</sup>**

Light intensity during heavily rainy days. You will not find any other solar power module reporting this figure, since the actual effective efficiency is **14.1% vs. 0%**.

**14.1% vs. 10.7%**

**Output voltage @ 100 W/m<sup>2</sup>**

**92.0% vs. 74.1%**

measured on percentage of rated voltage

Stable voltage output under low light conditions. For all solar cells in the market, the output voltage is too low to be useful.

**Effective Electric generation on an average day**

Using the same light reception area, Quasar's solar cell module double the amounts of effective electricity generated and with much lower cost.

**2 times**

**Effective Electric generation on a sunny day**

**1.1 times**

Still more output during any totally clear day. At the same time, less ultraviolet can reach the solar cell. Longer lifetime, less worries about maintainance.



## Cost breakdown

The designed lifetime of quantum light concentration material is 25 years (limited by the lifetime of solar cells attached).

In a city located at a latitude like Shanghai, for such a product with 1m<sup>2</sup> area, the total baseline effective electricity generation within a year is

$$9W \times 3000 \text{ hours} \times 25 \text{ years} = 675\text{kWh}$$

Assuming a 100kW<sub>p</sub>-output small-scale power station, the price of 1m<sup>2</sup> product is 200 CNY (31.5 USD). This price contains the maintenance fee and fees for associated inverters and transformers

Finally, the cost of electricity amounts to be  $200 \text{ CNY}/675\text{kWh} = 0.30 \text{ CNY/kWh}$  (0.042 USD/kWh).



**0.042USD/kWh**

highest possible cost (assuming bad weather persists)  
solar power module



**0.098USD/kWh**

highest possible cost (assuming bad weather persists)  
with storage battery  
independent power solution



**0.028USD/kWh**

yearly average cost  
solar power module



**0.084USD/kWh**

highest possible cost  
with storage battery  
independent power solution

1 USD ≈ 7.1 CNY

# Business Model

Based on the characteristics of quantum light concentration technology and our mission of providing the smart infrastructure for future cities, a three-stage integrated strategy to step into the market has been outlined.

Sources of revenue are:

- sales of solar panels (starting from stage I)
- electricity sales (starting from stage I)
- services from multi-functionality (starting from stage II)

As a start-up company, we will avoid direct competitions with large electricity providers. Instead, activating and inspiring other industries and create more values together with other strategic partners will be our goal.



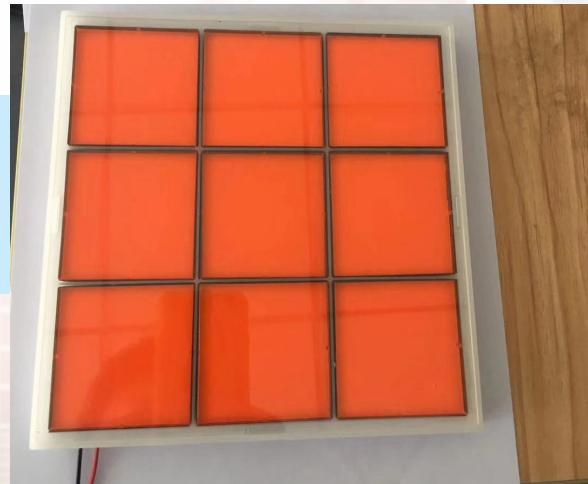
## Go-to-market plan

The initial shipment would go to our partner electricity providers for experimentation and demonstration. After that, QUASAR's products will appear in the market in the form as a strong competitor to all other market solar cells, when considering building new mega-solar power plants and solar systems for households.

In the meantime, we would propose the replacement of internal combustion power generation plants by our products in offshore islands.

Products presented in this stage shall be single-functional.

Counting from the construction of the first manufacturing line (50MW ~ 2.5 GW), this stage will last for 3~5 years.



Solar power charging stand with customizable shape.

For charging electric scooters



## Financial Forecast of Stage I

Income Statement	Forecast Period				
	FY1	FY2	FY3	FY4	FY5
<b>(1,000,000 USD)</b>					
<b>Revenue</b>	5.7	19.2	738.7	978.5	978.5
Cost of Goods Sold (COGS)	3.7	26.8	259.2	337.0	339.8
<b>Gross Profit</b>	2.0	-7.6	479.5	641.5	638.8
<b>Operating Expenses</b>					
Marketing, Advertising & Promotion	0.2	1.1	7.8	10.2	10.3
General & Administrative	1.4	9.5	148.2	194.6	195.4
Depreciation & Amortization	0.9	9.7	65.1	67.0	72.0
<b>Total Operating Expenses</b>	2.5	20.3	221.1	271.8	277.7
<b>EBIT</b>	-0.5	-27.8	258.4	369.7	361.1

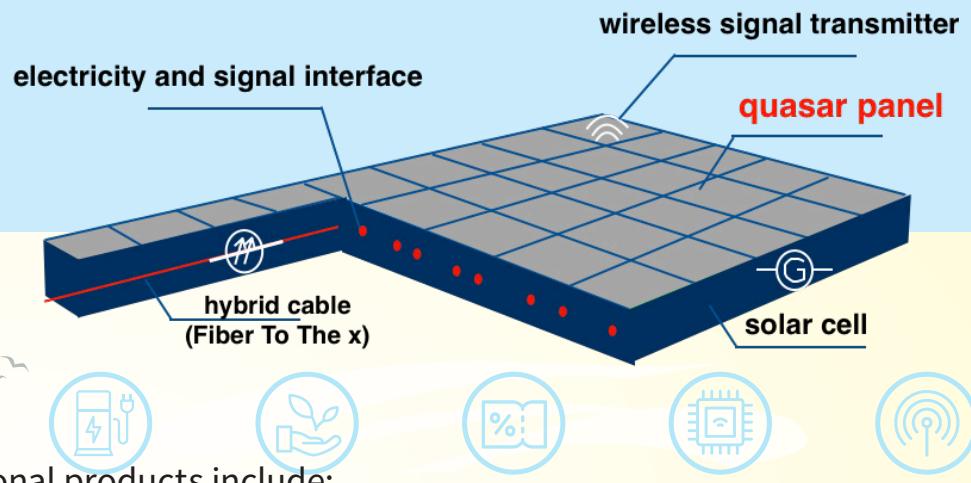


## Stage II

In this stage, we are devoted to present brand new innovative multi-functional products.

Along with the new market exploration process, we will be building alliance and partnership with companies from other industries such as electric car manufacturers, to furtherly enrich the spectrum of our clients.

Examples of our multi-functional products include:



## solar road

- embedded sensors and signal transmitters
- information exchange with vehicles and traffics calculation in real-time
- electricity to nearby electric vehicle charging stations
- Next generation automatic driving technology: from single-vehicle intelligence to cooperative intelligence between vehicles and roads

cooperative intelligence

information exchange between vehicles and roads

data collection in real-time

embedded sensors

## solar ground tiles

- for large outdoor areas such as city squares, pedestrian zones, and amusement parks.
- electricity for nearby public utilities
- embedded pressure sensors to detect crowd density

As multi-functional products can be counted as building materials, this leads to cheaper electricity cost. Our smart infrastructure products will provide a variety of public data collected. Furthermore, by combining with other cutting-edge smart city technologies such as 5G telecommunication, edge computing, and IoT, our partners and QUASAR would jointly present a complete solution to smart cities. They include solutions to:

- sensors and transmitters
- network
- new apps
- services

Together with our collaborators, we are ready to build a world with its digital space and physical space connected and integrated.



**This is the crossroads where technology and imagination meet each other, and we create new cities in the new world.**

### What we are not

QUASAR is not a start-up focusing on business model innovation, where ideas can be copied easily and competitions can be fierce. Nor are we trying to supply products with insufficient or undecidable demands.

### What we are

We are committed to provide a solution to a fundamental demand of human beings:

The **sources** and **liquidity** of energy.

As this is a fundamental demand, we strive to innovate solutions with higher demands building on it.

By 2020, the market size of smart city industry would reach 1.5 trillion dollars. Digitalizing people's daily life and renovate a city with truly smart infrastructure is not a new idea. However, its realization is greatly limited by current expensive cost of various components.

Unifying with QUASAR's technology, every building and outdoor public space can naturally become a electricity provider. This integration drastically reduce the cost of smart infrastructure and activate their performance.

This is the stage where QUASAR and our strategic partners together fully expanding the smart infrastructure plan globally. We are devoted to integrate our clean energy and smart building solution with industries ranging from artificial intelligence to zoology.



# Key Figures

**Electricity Price Reduction: 53%**

Compared with China's 0.65 CNY/kWh FIT price for PV power

**Quantum efficiency: 83%**

Quantum efficiency of the light concentration panel  
sustains for more than 25 years

# **0.028 USD vs. 0.041 USD**

Price of electricity per kWh  
Cheaper than coal-fired power in China.

# **6,994 TWh**

Electricity generation in China of year 2018  
70% of the total generation has a thermal source

# **200 billion USD**

Estimated global smart cities market size by 2025

# Epilogue



*Long time has passed since the last energy revolution.  
By hugely reducing the cost, we create new demands.  
QUASAR strives for helping our clients to build connections with energy, no  
matter when and no matter where.*

*As applications of a fundamental technology, we are not selling new products,  
but providing products catered for our clients' need in their daily life,  
with these products being photovoltaicized.*



*In this era boasted of booming techniques and innovations, now is time to ask, what is the core value of a technology?*

*It lies in solving a realistic problem with higher efficiency and lower cost.*

*Quantum light concentration technology is such a fundamental technology that provides a low-cost all-weather distributed solution to the problem of energy supply.*

*QUASAR is ready to present the world this magic for supporting high-quality low-carbon emission economic development, and inspiring more innovative solutions to the many challenges human beings are confronting with.*

*We are looking forward to create new values together with adventurers like you.*



# CONNECTING THE FUTURE



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Kyoto, Japan

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