Company Introduction

(HT-SAAE)

(SH:600151)
1.1 About Company History

China Aerospace S&T Corporation (CASC)

Parent Company -- China Aerospace S&T Corporation (CASC)

Space Technology -- CASC is mainly engaged in the research, design, manufacture and launch of space systems as well as strategic and tactical missiles, and also provides international commercial satellite launch service.

Financial Assets -- By the end of 2013, CASC had total assets of **RMB 294 billion**.
1.2 About HT-SAAE

Shanghai Aerospace Automobile Electromechanical Co., Ltd (HT-SAAE), Stock Code 600151. It is the first listed corporation named “Aerospace” and an important platform for aerospace technology industrialization.

The total assets of HT-SAAE is over RMB 10 billion, and the sales revenue of HT-SAAE in 2014 is over RMB 3.7 billion.
1.2 About HT-SAAE

Chinese Top Leaders Visiting

May 1960 Mao Zedong inspecting

February 1991 Den Xiaoping inspecting

September 1999 Jiang Zemin inspecting

July 2004 Hu Jintao inspecting

2013 Xi Jinping inspecting
Establishment of Shanghai Solar Energy Research Center

No. 2 EPC domestically
No. 4 EPC worldwide

Start to the research of solar application in the universe


- Products for civilian use
- The establishment of Shanghai Solar S&T Co. with production capacity of 5MW, leading the domestic PV industry at that time.
- Establishment of Shanghai Solar Energy Research Center
- Completion of the industrial distribution of PV vertical integration (polysilicon, wafers, solar cells, PV modules & system)
- Completion of Shanghai Expo Center Project with the capacity of 1MW
- No. 2 EPC domestically
- No. 4 EPC worldwide
- First completed the solar project in China with the capacity of 10 KW (rooftop project--Bright Project)
- 2014 Top 10 Chinese PV module supplier;
- Tested and certified by TUV Rheinland, the peak output power of N-type PERT high-efficiency mono-crystalline silicon solar module and that of HIGHWAY Plus photovoltaic module (based on 60 pieces of 156mm*156mm) reached up to 335.6Wp and 310.5Wp respectively, hitting the new record of silicon module products of the like in the industry.
- Milky Way--N-type PERT high-efficiency mono-crystalline silicon solar module has been used commercially.
- The manufacturing capacity of PV vertical integration (polysilicon, wafers, solar cells, PV modules & system) reaches to GW level.
1.4 Global Branches

- HT Holding Luxemburg S.A (Luxemburg)
- TRP PVE.B.V (Netherlands)
- HT Turkey (IST) In progress
- HT-SAAE (Shanghai)
- HT-Japan (Japan)
- Oriso Solar Inc. (America)
- Aerospace Photovoltaic (Spain)
- HT-India (India) In progress
- Aerospace Photovoltaic (Italy) In progress
- Shanghai HT Holding Hong Kong Ltd. (Hongkong)
- HT-South America (South America) In progress
- TRP PVE.B.V (Netherlands)
- HT-South Africa (South Africa) In progress
- HT-Australia (Australia) In progress
Based on the resource from state-owned enterprise, HT-SAAE has three main divisions: New Energy PV, Auto Parts and New Material Application.
1.6 Vertically-Integrated Industrial Chain

HT-SAAE has built the vertically-integrated industrial chain (polysilicon, wafers, solar cells, PV modules & system) at the level of GW.
1.6 Vertically-Integrated Industrial Chain

Vertically Integrated Industrial Chain

R&D
- Industrial Chain
- Silicon Material

Production
- Silicon
- Ingot
- Cell
- Equipment
- Wafer
- Module

EPC Sales & Marketing
- EPC China
- EPC Oversea
- Product Sales & Marketing
1.6 Vertically-Integrated Industrial Chain
1.6 Vertically-Integrated Industrial Chain

Silicon Materials Production
Orisi Silicon: By introducing the advanced polysilicon process technologies and equipment from abroad, HT-SAAE has created the Aerospace PV Industry Manufacturing Base in Inner Mongolia.

Silicon Ingot & Wafer Production
Aerospace PV Wafer Production Center (Ingot, Pulling, Slice): Owns the complete wafer production line from crystal growth to wafer processing.
1.6 Vertically-Integrated Industrial Chain

Solar Cells & Modules Production
Shanghai Shenzhou New Energy Development Co., Ltd.
Mainly engaged in the research & development of new energy PV technology and the solar cells production. It is an important manufacturing base of Aerospace PV Industry Chain.

Lian Yungang Shenzhou New Energy Co., Ltd.
Mainly working on the research & development, producing and selling PV modules, as well as devoted into producing, selling and service of the related test device and ancillary products.
1.6 Vertically-Integrated Industrial Chain

**PV System Integration Center**

Shanghai Solar Energy SAT Co., Ltd.
Mainly engaged in the design, development, selling, construction, and services of large on-grid PV power station, stand-alone PV power station, BIPV independent PV system, and other interconnection system products.

**Research Center**

Shanghai Solar Energy Research Center (R&D)
The municipal research center focuses on the research, development and application for solar PV technology.
2.1 Core Competitive Advantages

- R&D History & Advantage
- Vertically-integrated Industrial Chain
- Systems Integration
- Financial Steadiness

Core Competitive Advantages
## 2.1 Core Competitive Advantages

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<th>R&amp;D History &amp; Advantage</th>
<th>Vertically-integrated Industrial Chain</th>
<th>Systems Integration</th>
<th>Financial Steadiness</th>
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</thead>
<tbody>
<tr>
<td>• Based on 55 years experience in R&amp;D of solar technology from CASC</td>
<td>• The manufacturing capacity of silicon materials has reached up to 6000 tons.</td>
<td>• Built up over 600 PV power stations home and abroad</td>
<td>• Get financial support from national development banks and domestic major banks</td>
</tr>
<tr>
<td>• 15 years experience in aerospace PV commercialization</td>
<td>• The manufacturing capacity of PV vertically-integrated industrial chain (polysilicon, wafers, solar cells, PV modules &amp; system) has reached up to GW level.</td>
<td>• The capacity of PV system integration has reached up to GW level.</td>
<td>• Gets the concessional loans from CASC</td>
</tr>
<tr>
<td>• Built industrial base in Shanghai, Inner Mongolia and Jiangsu Province.</td>
<td></td>
<td>• No. 2 EPC supplier domestically; No. 4 EPC supplier worldwide</td>
<td>• Total assets is over 10 billion</td>
</tr>
<tr>
<td>• 1 national, 5 provincial and municipal R&amp;D centers, 5 high-tech corporations.</td>
<td></td>
<td>• Have a great team with abundant experience in power plant construction and stability maintenance.</td>
<td>• Assets-liability ratio is lower than rest of the industry</td>
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<tr>
<td>• Owns over 50 independent intellectual property rights for cell &amp; module</td>
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<td></td>
<td>• 2 capital operation platforms oversea</td>
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<tr>
<td>• 10 million+ USD R&amp;D investment per year</td>
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</table>
With conservative capacity expansion strategy, ever since 2010, HT-SAAE’s compound annual shipment growth rate has been much higher than the global compound annual growth rate.

**2.2 Great Market Performance**

*HT-SAAE Shipment (MW)*

Compound Annual Growth Rate **87%**

*Global Market Demand Growth (GW)*

Compound Annual Growth Rate **38.6%**
### 2.3 Awards

<table>
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<tr>
<th>Awards of 2013</th>
<th>Awards of 2014</th>
<th>Awards of 2015 (as of May)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.4 in “2013 Total Power Station EPC Ranking List” (Data from world famous market research institute IHS)</td>
<td>2014 Top 10 Chinese PV Module Supplier (Data from NPD Solarbuzz)</td>
<td>11th of TOP 20 Chinese Investment Companies on PV Power Plant (Data from PVP365)</td>
</tr>
<tr>
<td>2013 Second Largest PV EPC Enterprise in China (Data from international authoritative PV market research institute NPD Solarbuzz)</td>
<td>NO.3 in EPC Brand Value List of Chinese PV Ranking (Data from Photovoltaic Brand Lab &amp; <a href="http://www.ne21.com">www.ne21.com</a>)</td>
<td>7th of TOP 20 Chinese PV Power Plant EPC General Contractor (Data from PVP365)</td>
</tr>
<tr>
<td>2013 China PV Power Station Business Achievement Award (Data from PVP365)</td>
<td>Top 10 in Module Brand Value List of Chinese PV Ranking (Data from Photovoltaic Brand Lab &amp; <a href="http://www.ne21.com">www.ne21.com</a>)</td>
<td>11th of TOP 20 Chinese PV Modules Enterprise (Data from PVP365)</td>
</tr>
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<td>2013 PV Power Station Best Performance for listing Corporation (Data from PVP365)</td>
<td>2014 Second Largest PV EPC Enterprise in China (Data from NPD Solarbuzz)</td>
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<td></td>
<td>2014 Chinese PV Power Station Best Performance for listing Corporation (Data from PVP365)</td>
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<td>2014 Chinese PV Power Station Good Quality Awards (Data from PVP365)</td>
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<td>2014 TOP 20 Chinese PV Power Station EPC General Contractor (Data from PVP365)</td>
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<td>2014 TOP 20 Chinese PV Power Station Investment Enterprise (Data from PVP365)</td>
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<td></td>
<td>2014 TOP 20 Chinese PV Modules Enterprise (Data from PVP365)</td>
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</table>
3.1 Technological Achievements

Mono-crystalline silicon

335.6Wp

Milky Way -- Bifacial N-type PERT mono-crystalline silicon solar module

Poly-crystalline silicon

310.5Wp

HIGHWAY Plus photovoltaic module (based on 60 pieces of 156mm*156mm)

On the January 2015, tested and certified by TUV Rheinland, the peak output power of N-type PERT high-efficiency mono-crystalline silicon solar module and that of HIGHWAY Plus photovoltaic module (based on 60 pieces of 156mm*156mm) reached up to 335.6Wp and 310.5Wp respectively, hitting the new record of silicon module products of the like in the industry.
3.2 Road Map

Mid-and-long Term R&D Road Map (2015-2017)

- HT60-156M(ND)≥285W
- HT60-156M(ND)≥295W
- HT60-156M(ND)≥305W
- HT60-156M(ND)≥315W
3.3 Product Line

Normal Product
- Three Bus Bar

HT60-156P
HT60-156M
HT72-156P
HT72-156M
3.3 Product Line

Highway Products

- HIGHWAY photovoltaic module

HT60-156P-4BB  HT72-156P-4BB  HT48-156M-4BB  HT50-156M-4BB  HT60-156M-4BB  HT72-156M-4BB
3.3 Product Line

Milky Way -- Bifacial N-type PERT mono-crystalline silicon solar module

- HT60-156M (ND)
  - Pmax: 285Wp
  - NO. of cells: 60
  - Transmittance: 10.6%

- HT54-156M (ND)
  - Pmax: 255Wp
  - NO. of cells: 54
  - Transmittance: 21.6%

- HT48-156M (ND)
  - Pmax: 230Wp
  - NO. of cells: 48
  - Transmittance: 30.3%

- HT42-156M (ND)
  - Pmax: 200Wp
  - NO. of cells: 42
  - Transmittance: 40%

- meet the different requirement of light for buildings and plants
- Frame Version/Frameless Version
- Optional Transparent Back Sheet/Back Sheet
3.3 Product Line

- Higher module power (285Wp+)
- Double glass bifacial module
- Better low irradiation response
- Zero initial light induced degradation (LID)
- Potential induced degradation (PID) resistant
- 30 years power output warranty on
### 4.1 Certificates

#### International Certificates

<table>
<thead>
<tr>
<th>Country</th>
<th>Certification</th>
<th>Region</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>China General Certification</td>
<td>Europe</td>
<td>PV CYCLE</td>
</tr>
<tr>
<td>China</td>
<td>Environmental Label Certification</td>
<td>Canada</td>
<td>CSA</td>
</tr>
<tr>
<td>Europe</td>
<td>CE</td>
<td>Britain</td>
<td>MCS</td>
</tr>
<tr>
<td>America</td>
<td>CEC</td>
<td>Europe</td>
<td>TÜV SÜD</td>
</tr>
<tr>
<td>Australia</td>
<td>Clean Energy Council</td>
<td>Europe</td>
<td>TUV Rheinland</td>
</tr>
<tr>
<td>Italy</td>
<td>Registro Italiano Navale</td>
<td>America</td>
<td>UL</td>
</tr>
<tr>
<td>Japan</td>
<td>JET</td>
<td>Korea</td>
<td>KTL</td>
</tr>
</tbody>
</table>
4.2 Global Partners
5.1 Projects  Reference

- Solar station in North Tibet
- Solar application in Shanghai Expo
- Solar plant in open field
- Solar application in space
- Rooftop solar system
- Solar parking lot
In 2002, we undertook the national “Bright Project”, to build 42 power stations (1.2MWp) in Tibet, which has brought electricity to hundreds of thousand people for their living, work and study.
5.2 Domestic Projects

Built up Shanghai Solar Energy Research Center since 2006, the installed energy capacity of this BIPV system is 1MW.
## 5.2 Domestic Projects

<table>
<thead>
<tr>
<th>Year</th>
<th>Project Description</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Rooftop system for Shanghai Expo 2010</td>
<td>1MW</td>
</tr>
<tr>
<td></td>
<td>Parking lot at Shanghai Academy of Spaceflight</td>
<td>2.3MW</td>
</tr>
<tr>
<td></td>
<td>Shanghai Hongqiao Transportation Hub</td>
<td>6.57MW</td>
</tr>
</tbody>
</table>
5.2 Domestic Projects

2011

Jiayuguan 10 MW PV Project
Location: Jiayuguan, Gansu Province, China
5.2 Domestic Projects

ZHANGYE 18MW PV Project
Location: Zhangye, Gansu Province, China
5.2 Domestic Projects

2012

Jiayuguan 27MW PV Project
Location: Jiayuguan, Gansu Province, China
5.2 Domestic Projects

2013

QINGHAI GANGCHA 20MW PV Project
Location: Qinghai Province, China
5.2 Domestic Projects

2013

GANSU GAOTAO 50MW PV Project
Location: Gaotai, Gansu Province, China

Power Output KWH
- First year: 97,950,000
- In total 25 years: 1,956,250,000
- Annual average: 78,250,000
5.2 Domestic Projects

2013

GANSU Jiayuguan 130 MW PV Project
Location: Gansu Province, China
5.2 Domestic Projects

2013

Ningxia Zhongwei 30 MW PV Project
Location: Zhongwei, Gansu Province, China
5.2 Domestic Projects

2014

YONGDENG 49.5MW PV Project

- The first large-scale on-grid and ground mounting photovoltaic power plant of Lanzhou
- HT-SAAE’S first power plant certificated by TÜV
5.2 Domestic Projects

2014

1st phase of Ningdong PV project
Capacity: 100MW
Location: Ningdong, Ningxia Province
The first big scale mounted project with 100MW capacity in Ningxia Province
5.3 Oversea Projects

- **Puglia, Italy**
  - Capacity: 1MW

- **Syracuse, Italy**
  - Capacity: 4.8 MW

- **Sardinia, Italy**
  - Capacity: 11.8 MW
5.3 Oversea Projects

Solar Plant In Germany
Capacity: 5MW

Solar Plant in Germany
Capacity: 3.2MW
5.3 Oversea Projects

- Thailand
  - Capacity: 5KW

- Germany
  - Capacity: 1.2KW

- Korea
  - Capacity: 1.5MW
5.4 Off-grid Projects

- Off-grid System in Tibet
  Capacity: 10~50KW

- Off-grid Generation System in Qinghai
  Capacity: 20KW

- Base-station in Libya
  Capacity: 5KW

- Base-station in Sichuan
  Capacity: 5KW

- Wind and Solar Hybrid System in Gansu
  Capacity: 50KW
5.5 Application Projects

PV Pump System, Xinjiang

Solar Lawn Light

Environmental Monitoring, Shanghai

On & Off Shore Light Beacons
The End