

# **Jawaharlal Nehru National Solar Mission**

## **Recommendations of the Committee set up for promotion of Manufacturing in Solar Energy in India**

**8<sup>th</sup> February, 2010**

## Foreword

This Committee was set up to recommend a policy framework under the Jawaharlal Nehru National Solar Mission to encourage domestic production of raw materials and components required for expanding the domestic industrial base by identifying the critical elements/components which lend themselves to indigenous manufacture and recommend the minimum indigenous content for solar power projects, both solar thermal and photovoltaics.

The Committee held detailed consultations with developers, manufacturers, technology providers and Industry Associations in a transparent manner.

Part 1 of the report of the Committee is being submitted. This addresses the Terms of Reference of the Committee partially. Part 2 of the report will address the remaining Terms of reference.

The recommendations contained in Part 1 may be considered while finalizing the guidelines for selection of new Project Developers for Phase 1 of the Mission.

*Ajay Shankar*  
(Ajay Shankar) 8/2/2010  
Chairman

## Executive summary

1. The Jawaharlal Nehru National Solar Mission was launched on the 11<sup>th</sup> January, 2010 by the Prime Minister. The Mission has set the ambitious target of deploying 20,000 MW of grid connected solar power by 2022. The Solar Mission has the potential of transforming India's energy security and contributing to national as well as global efforts to combat climate change.
2. The Prime Minister, while launching the Solar Mission, stated that "I sincerely hope that this Solar Mission will also establish India as a global leader in solar energy, not just in terms of solar power generation but also in solar manufacturing and generation of this technology". The Mission document has stressed the need for promoting indigenization as deployment progresses and states that the requirement of phased indigenization would be specified while seeking development of solar power projects.
3. The first phase of the Mission (2010-2013), inter alia, envisages the development of 1000 MW of solar energy to be developed and procured through the NVVN(NTPC Vidyut Vyapar Nigam), which would bundle this with 1000 MW of unallocated power of NTPC with the Central Government and this bundled energy would be sold to Discoms. The price of this bundled energy would be around the prevailing market price and therefore, the sale of this bundled energy would be reasonably assured.
4. Phase I of the Mission is expected to build the foundation of the Mission with appropriate policy interventions to attract industry and project developers to invest in research, domestic manufacturing and development of solar power generation. This phase is envisaged to nucleate the critical mass for making India a globally competitive hub for solar power development and manufacturing.
5. The Committee was set up to recommend a policy framework to encourage domestic production of raw materials and components required for expanding the domestic industrial base by identifying the critical elements/components which lend themselves to indigenous manufacture and recommend the minimum indigenous content for solar power projects, both solar thermal and photovoltaics. The Committee held detailed consultations with developers, manufacturers, technology providers and Industry Associations in a transparent manner.
6. The Committee has concluded that the key elements for the attainment of the objectives of the Solar Mission relating to manufacturing and technology development in India are the following:

- Scaling up of the size of the market for domestic manufacturers. This would require prescription of mandatory domestic manufacturing for critical elements of solar energy systems normally for 7 years. This would provide a credible signal for attracting new entrants both domestic and foreign, into the sector. Scale is critical to downward movement on the cost curve.
- Creating a competitive industry structure in India; competition being the key to innovation and cost reduction.
- On achieving the above two objectives to a reasonable degree, moving towards competitive procurement based on the price of solar electricity. This would spur innovation and movement of solar power towards grid parity.
- Remain technology neutral within the broad categories of Solar PV and Solar Thermal. Give every emerging technology ample space to enter with a fair chance of moving down the cost curve. This is necessary as the sector appears to be on the cusp of transformational changes involving both incremental as well as disruptive innovation.

### **Recommendations**

7. Based on the above approach the Committee recommends the following:

#### **A. Solar Photovoltaic**

Recommendation for domestic content is being restricted to critical element of the Solar PV systems only.

- a. Mandate that for Phase 1 of the Mission, all deployment in grid connected solar power be done using both cells and modules manufactured in India.
- b. In year 2012-13, all installations be mandated to use Power Conditioning Units (PCUs) made in India. This requirement would enable adequate investments in PCUs manufacturing to be made by 2011-12 with international efficiency levels.
- c. A review may be done in 2013-14 to see if the mandate could be extended to wafers and silicon being made in India for the subsequent years.

#### **B. Solar Thermal**

Mandate 30% of local content for all plants in solar thermal technology. The technology providers in their submissions to the Committee had indicated that a higher level than 30% of domestic content could be feasible at the outset. The Committee, however, is of the view that this is a new and emerging technology where there are few global players of scale. Hence there is need to prescribe only a modest domestic content requirement so as not to deter or inhibit competitive entry into the Indian market of this technology.

It is also recommended that the projects of Solar thermal which would be sanctioned in the year 2012-2013 have 50% local content mandated as by then some domestic manufacturing capability is expected to emerge.

By 2012-13, a clearer picture would emerge regarding the critical elements of this technology and the potential for their manufacturing in India and based on that assessment phased increase in mandatory indigenization could be considered for the subsequent years.

8. The Committee also took note of the fact that since technology is rapidly evolving in the field of Solar PV, there is a need to provide ample opportunity for deployment of the latest technologies, selectively, through projects, under the Mission wherein the developers could tie up with proven technology providers/module manufacturers that offer better efficiency and/or technology than what is available and being deployed in India. It is accordingly recommended that the condition of local content may be relaxed for such projects. The decision to permit the setting up of such plants in India may be taken by an Empowered Committee, after an evaluation of the technology being proposed, for greater efficiency or novelty holding the promise of cost reduction. The relaxation of domestic content requirement should be such as to provide for deployment of a critical mass in field conditions in India, after which the condition of domestic manufacturing for the new technology/product which is more efficient may be prescribed. This approach is necessary to facilitate the entry of new and more efficient technologies in the country. This would help India move up the technology development curve faster. Such an approach for Solar Thermal may be considered in 2012-2013 by when critical elements of Solar Thermal Technology would get identified for domestic manufacturing. Till then, the domestic content requirement that is being mandated is quite modest and in the view of Committee easily achievable.

## Chapter 1

### **National Solar Mission**

1.1 The Jawaharlal Nehru National Solar Mission was launched on the 11<sup>th</sup> January, 2010 by the Prime Minister. The Mission has set ambitious target of deploying 20,000 MW of grid connected solar power by 2022. The Solar Mission has the potential of transforming India's energy security and contributing to national as well as global efforts to combat climate change. The Prime Minister, while launching the Solar Mission, stated that "I sincerely hope that this Solar Mission will also establish India as a global leader in solar energy, not just in terms of solar power generation but also in solar manufacturing and generation of this technology". The Mission document has stressed the need for promoting indigenization as deployment progresses and states that the requirement of phased indigenization would be specified while seeking development of solar power projects.

1.2 Solar energy, at present is quite expensive compared to other sources of power such as coal. The objective of the Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity.

1.3 The Mission has stated that the cost trajectory towards grid parity would depend upon the scale of global deployment and technology development and transfer. Both the technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaics, have been considered for providing scalability for solar power in India.

1.4 It is envisaged in the Mission that a 3 phase approach shall be adopted. First phase would extend up to 2012-2013 and target 1100 MW of grid solar electricity as well as 200 MW of off- grid systems. Mission aspires to achieve a cumulative target of 20000 MW capacity of grid connected solar projects and 2000 MW capacity through off grid projects by 2022 by the end of Phase 3. The first phase of the Mission is expected to build the foundation with appropriate policy interventions and create the necessary environment to attract industry and project developers to invest in research, domestic manufacturing, value addition and development of solar power generation and thus nucleate the critical mass for domestic production.

1.5 The Mission document has stressed the need for promoting indigenization as the deployment progresses and states that "the requirement of phased indigenization would be specified while seeking development of solar power projects under this scheme. The size of each project would be determined so as to make phased

indigenization feasible. The tariff and tax regime for key components and segments would be suitably fine tuned so as to promote the process of indigenization.”

1.6 By the end of 2022, the deployment of solar systems in India would be quite comparable with similar installations in the rest of the world. Therefore, it is imperative that the benefit of such a large scale deployment should come to the country in the form of indigenous expertise, skill development, employment creation, manufacturing capacity and value addition.

## Chapter 2

### **Committee for Promoting Domestic Production**

2.1 A Committee was set up to recommend a policy framework to encourage domestic production of raw materials and components required for expanding the domestic industrial base by identifying the critical elements/components which lend themselves for indigenous manufacture and recommend the minimum indigenous content for solar power projects, both solar thermal and photovoltaics. Details at Annex 1

2.2 The composition of the Committee is as follows:-

- |  |          |
|--|----------|
| i. Shri Ajay Shankar                         | Chairman |
| ii. Advisor, Planning Commission             | Member   |
| iii. DG, BEE                                 | Member   |
| iv. Secretary CERC                           | Member   |
| v. CMD, IREDA                                | Member   |
| vi. CEO, PFCCL                               | Member   |
| Representatives of the following as members: |          |
| vii. Scientist 'F' from MNRE                 |          |
| viii. NMCC                                   |          |
| ix. CEA                                      |          |
| x. MoP                                       |          |
| xi. NTPC/NVVN                                |          |
| xii. State of Gujarat                        |          |
| xiii. State of Rajasthan                     |          |
| xiv. JS, MNRE                                | Convener |

2.3 Terms of Reference of the Committee are as follows:

- a) To review the present status of domestic industry, indigenous content and barriers in indigenization and the existing policies and incentives available to the industry.
- b) To identify the critical elements/components which lend themselves for indigenous manufacture and cost reduction on account of economies of scale.
- c) To recommend policy framework and specifically the incentives and procedures to be adopted to encourage domestic solar thermal industry in the country. SME sector presents a critical interface



especially for Balance of systems and should also be considered for appropriate incentives

- d) To recommend the minimum indigenous content for solar power projects, both solar thermal and photovoltaics
- e) To project the estimated requirement of funds for implementing the above.
- f) To recommend policy interventions to encourage domestic production of raw materials and components ( not covered under the SIP policy) required for expanding the domestic industrial base.
- g) Any other related matter Committee may like to recommend, keeping in view the policy intent detailed in the National Solar Mission document.

2.4 Committee could also co-opt any other member or experts as considered necessary and also call persons/ institutions/associations/entities as special invitees.

#### **Stakeholder Consultations**

2.5 The Committee had a series of meetings with various stakeholders including manufacturers , developers and technology providers of solar photovoltaic and solar thermal devices/systems.

2.6 In the first meeting, the terms of reference for the Committee were explained and the participants were invited to present their views.

2.7 The present status of the solar thermal manufacturing industry, various components and the possibility of manufacturing the components in India were discussed. It emerged that the Indian industry has sufficient manufacturing capacity to supply the required volume of solar PV modules for the Mission's target during Phase 1. In case of solar thermal, the technology is still evolving. However the capability exists in India to produce most of the balance of system components indigenously. Presentations made by various stakeholders are at Annex 2.1 to 2.9

2.8 The view was expressed that the Solar Mission Document outlines the need to put in place a Solar RPO but if this requirement is to be fulfilled there must be sufficient supply of solar power. Thus any condition of local content should be pragmatic and a graduated approach may be followed.

2.9 It was pointed out that bulk tenders for super critical thermal plants with domestic manufacturing requirement was one model that Government had adopted for promoting manufacturing in a new and high end technology area. A similar approach for setting up of large solar thermal power projects could also be considered.

2.10 The following issues emerged during discussions

- a) What percentage of local content requirement is realistic in the solar technologies? There are some critical components wherein manufacturing in India should be pro-actively targeted.
- a) The mechanism for linking the selection guidelines, which would be followed by NRVN to select developers to the local content requirement.
- b) Phasing of domestic content requirement.

2.11 In the next set of deliberations, manufacturers and technology providers were called and they made detailed presentations before the Committee. The status of global and domestic technology levels, deployment and manufacturing capacity were presented. The various solar thermal technology providers also shared their cost estimates with the Committee. The Committee requested various project developers in Solar thermal technology to detail out a plan for indigenization based on capacity addition.

2.12 In the final deliberations, which took place on 3rd February 2010, the Committee heard the views of manufacturers and solar power developers in Solar PV sector and developers of Solar Thermal Power.

2.13 The points raised by representatives of different solar power developers are summarized below:-

- a) That the long term performance of the systems with matching performance warranties backed by global insurance companies is a pre-requisite for obtaining financial closure.
- b) That from the point of view of developers, the project IRR is critical and this gets maximized if the developer uses solar components that are highest performing and are available at the lowest cost and for which field track record is also available. Any local content stipulation could have an adverse impact on the ability of developers to get the most competitive product in terms of efficiency, quality and cost
- c) That financially strong suppliers also offer suppliers credit during the construction period thereby bringing down the interest cost.
- d) That in a SPV installation, 70% of the cost is comprised of modules and Power Conditioning Unit (PCU) and hence any local content

requirement above 30% would imply that modules would have to be bought from only Indian companies since high efficiency PCUs in any case would need to be imported at present.

- e) That the impact of local content requirement in Ontario (Canada market) has made it difficult for global companies, in managing their global supply chain.

2.14 The views of the manufacturers of SPV are summarized below:-

- a) That world class manufacturing facilities exist in the country and Indian manufacturers have been exporting PV modules for grid connected applications abroad. It would be ironical if the Indian grid connected Solar PV program has to depend on imports of such modules.
- b) That the significant subsidies that are inbuilt in the Solar Mission needs to be directed towards domestic manufacturing, creation of employment and value addition in the country.
- c) That Indian manufacturers also provide long term performance warranties backed by global insurance companies as this is a pre-requisite for selling products abroad.
- d) That the Indian products are competing globally on both costs and quality.
- e) That the scale and the ambition envisaged in the Solar Mission provides the country an opportunity to attract global companies to set up manufacturing base in India and the stipulation of local content may actually catalyze this process.

2.15 The views of the technology providers in Solar Thermal are summarized below:-

- a) That in the parabolic trough collector technology, the critical components are the turbine, heat transfer fluid, mirrors and solar receivers. This forms about 40% of the total cost of the project and the remaining 60% is the cost of structures, civil works and other soft costs including engineering and design costs.
- b) That turbines upto 60 MW capacity suitable for solar project can be manufactured in India with a very short gestation period. There is also a possibility of mirror manufacturers putting up manufacturing lines provided that the market for these specialized mirrors is assured. Heat

- transfer fluid and solar receivers may require to be imported for some time to come.
- c) That in the tower technology, the import content at present is about 70% but with a capacity addition of 300-500 MW over 5 to 6 years, this can get reduced to 10-15%.
- d) That the balance of system including power block and structures are amenable to indigenization even in the initial projects.

2.16 The Committee heard the views of all the stakeholders and also gave them opportunities to voice their concerns and views. In addition to participation in the meetings of the Committee, views were also obtained through E-mail and letters. Since consultative meetings for preparation of guidelines for selection of projects under the grid connected component as also meetings with industry for eliciting R&D projects have been on-going for the last two months, the participants in these meetings were also informed about the work of this Committee and were encouraged to send their views.

2.17 This report of the Committee, Part 1, has addressed Terms of Reference of the Committee partially. Part 2 of the report will address the remaining Terms of reference. The recommendations contained in Part 1 may be considered while finalizing the guidelines for selection of new Project Developers (excluding those under migration scheme) for Phase 1 of the Mission.

## Chapter 3

### Approach

3.1 Solar energy sector appears to be on the cusp of a major transformation. There is general optimism about the feasibility of attaining grid parity in the foreseeable future. There are, however, considerable variations in estimations regarding the time frame for achieving significant cost reductions. There are promising efforts at developing new technologies and processes across the world. With increasing emphasis on promotion of renewable energy in the context of the challenge of climate change, such efforts are increasing in size and scope. Both incremental as well as disruptive innovations are expected in the coming years on a significant scale.

In view of the diverse range of R&D efforts being undertaken it was felt that at this stage it would be desirable to remain technology neutral. The objective should be to give every emerging technology ample space to enter and be deployed and supported under the Mission. This would provide a real test of the technology in field conditions and also enable movement down the cost curve.

3.2 The mandate of the Committee is to make recommendations for promotion of domestic manufacturing to make India a globally competitive hub for solar power development.

3.3 In this context, the Committee noted the success of India in becoming a globally competitive location for development and manufacture of small fuel efficient cars. Similarly, India has become a global hub for manufacture of low priced generic drugs. In each of these sectors success has depended to a large extent on a growing large domestic market which for a critical period was available exclusively for domestic manufacturers.

3.4 Scale is crucial for achieving the ability to innovate as well as the capacity to compete in the global market. The Solar Mission has created the scale effect and the size of the Solar Mission's Programme is large enough for the creation of a globally competitive solar manufacturing industry in India.

3.5 The Committee took note of:

- Offsets in Defence and Civil Aviation procurement. In Defence procurement, 30% domestic content through offsets is now mandatory under the procurement policy of the Ministry of Defence.

- Recent example of the US Government imposing "buy American" condition on funds released under the stimulus packages.
- The Ontario Canada FIT Programme which mandates domestic content requirement for their solar energy programme.

The Committee noted that public procurement is outside the purview of India's WTO and other international obligations.

3.6 The Programme involves bundling of unallocated NTPC power of 1000 MW with solar power of a 1000 MW to be developed in Phase-1 of the Solar Mission and the sale of the bundled power to the Discoms (Distribution Companies). The 1000 MW of solar power is to be procured publically by NVVN for this purpose and this is in the nature of public procurement.

3.7 At present, solar energy systems have two subsets. The solar subset involves conversion of solar energy directly into electricity or into heat which can then be used to generate electricity. The non-solar subset comprises elements which are part of the normal electrical equipment industry for converting heat into electricity and transmitting it onwards or transforming DC power to grid power.

3.8 The Committee felt that the efforts in promoting domestic manufacturing should focus on the solar subset of solar energy systems. The non-solar subset may have certain special requirements but these elements are part of an electrical equipment industry which in India is sufficiently developed and mature. It is in the critical elements of the solar subset that there is need to ensure the growth of domestic manufacturing and value addition. The Committee therefore feels that prescribing domestic content requirement for critical elements of the solar subset would be the most effective policy instrument to ensure that the Solar Mission leads to India's emergence as a globally competitive centre for manufacturing solar energy systems as well as for innovation. Such domestic manufacturing requirements would provide a credible signal for attracting new entrants both domestic and foreign and create a competitive industry structure. There are no entry barriers in this sector in the Indian market. The size of the market of 1000 MW in Phase 1 going up to 20,000 MW by 2022 is large enough to be sufficiently attractive for all global players as they consider options for the development of their global supply chains. While recommending local content requirements for a limited period, the Committee has consciously ensured that such requirements are phased in a manner that sufficient numbers of manufacturers are available in the domestic market. The creation of a competitive industry structure is important as competition is the key to innovation and cost reduction.

3.9 Mandatory domestic content requirement may normally be restricted for 7 years for a particular element/component, by which time the domestic industry can be expected to have acquired critical mass as well as global competitiveness. The prescription of mandatory domestic content requirement does have the implication of reducing price competition from overseas. It should, therefore, normally be avoided. However, if domestic industry acquires the critical mass and a competitive structure then the speed with which it moves down the cost curve more than adequately justifies the downside of reduced price competition in the initial phase. Further, the absence of international price competition is being restricted to 7 years for specific components/sub-systems. At the end of a review after five years, the time for exit may be notified. Seven years is considered reasonable as the intention is to send a credible signal for attracting new entrants/ investments in manufacturing in India. As it takes 2-3 years for production to commence for green field projects; the availability of a secure market for 4-5 years appears reasonable before introducing price competition from overseas.

3.10 Once the domestic industry has achieved the necessary scale as well as a competitive structure to a reasonable degree it would be desirable to move towards competitive procurement of solar electricity on tariff. Tariff based bidding has been seen to have spurred innovation and significant lowering of prices. The ultimate objective for solar electricity is to achieve grid parity. Innovation and frugal engineering where India is acquiring the right eco-system would be the key to movement towards grid parity.

3.11 The Committee also took note of the fact that since technology is rapidly evolving in the field of Solar PV, there is a need to provide ample opportunity for deployment of the latest technologies, selectively, through projects under the Mission wherein the developers could tie up with proven technology providers/module manufacturers that offer better efficiency and/or technology than what is available and being deployed in India. It is accordingly recommended that the condition of local content may be relaxed for such projects. The decision to permit the setting up of such plants in India may be taken by an Empowered Committee, after an evaluation of the technology, being proposed for greater efficiency or novelty holding the promise of cost reduction. Further, its successful field operation for at least two years should be a pre-condition for such projects. The relaxation of domestic content requirement should be such as to provide for deployment of a critical mass in field conditions in India, after which the condition of domestic manufacturing for the new technology/product which is more efficient or cost effective may be prescribed. This approach is necessary to facilitate the entry of new and more efficient technologies in the country. This would help India move up the technology development curve faster.

3.12 Such an approach for Solar Thermal may be considered in 2012-2013 by when critical elements of Solar Thermal Technology would get identified for domestic manufacturing. Till then, the domestic content requirement that is being mandated is quite modest and in the view of Committee easily achievable.



## Chapter 4

### **Recommendations**

#### Solar PV Systems

4.1 In Solar PV power systems, the 2 major sub-systems are Solar PV modules and Balance of Systems (BOS). Solar PV modules constitute 65-70% of the cost while BOS comprises the rest.

4.2 The BOS is part of the normal electrical equipment industry needing transformers, cables etc. Indian industry is sufficiently developed and mature in this area and therefore prescription of any mandatory domestic content requirement is not considered necessary. Though power conditioning units (PCUs) are made in India, these need to achieve international levels in terms of efficiency. However, the manufacturing capacity in this regard can be quickly created in India. Given the size of the Solar Mission Programme, it is felt that this capacity should be created and therefore the Committee recommends that it should be mandatory from 2012 that only indigenously manufactured PCUs be used in projects under the Solar Mission. It is hoped that this policy signal would provide an adequate push for investments in manufacturing products which meet the international efficiency levels.

4.3 The focus of the Committee has been on the Solar PV modules. These constitute the heart of the solar system. Solar PV modules are predominantly crystalline silicon based. Within the module, the intermediate products at different stages of the manufacturing process are as follows:-

- i. Poly-silicon
- ii. Silicon Wafer
- iii. Solar Cell
- iv. Solar PV Module

For items (i) and (ii) above, there is presently nil or negligible domestic manufacturing capacity, though some companies have plans to invest in this area. The SIPS policy of the IT Ministry is aimed at promoting the development of such manufacturing capacity and it is expected that the first plants may become functional by 2013 onwards. Accordingly, the prescription of mandatory domestic content for this segment can be considered only by the year 2013.

For items (iii), there is capacity for manufacture of over 600 MW annually within about 15 companies. Details are given at Annex 3. The quality and the efficiencies compare well with products available elsewhere in the world.

For item (iv), there are 20 major manufacturers with cumulative capacity of more than 1000 MW annually. Details are at Annex 3. The PV modules manufactured in the country meet relevant international standards.

4.4 Thin film PV technologies are emerging as an alternative to crystalline silicon solar cells. Presently, there are fewer companies globally who manufacture thin film solar cells on a commercial scale as compared to crystalline silicon. Manufacturing activities for thin film solar modules have recently commenced in India.

4.5 Based on the approach outlined in the preceding chapter, it is felt that it be mandated that both cells and modules be manufactured in India for projects to be eligible for inclusion in Phase 1 of the Mission. This would spur competitive entry and growth of the domestic industry and give it necessary protection from the threat of artificially cheap imports. Such protection is necessary and desirable given the objective of the Solar Mission to have a globally competitive manufacturing industry in India. As indicated in chapter 3, this would still leave space for relaxation of domestic content requirement for new technology with higher efficiencies.

4.6 This Programme has as yet no international financial grant or concessional finance to support it. For projects to be taken up with international grant/concessional financing as and when this becomes available the requirement of mandatory domestic manufacturing for key elements may have to be dispensed with.

4.7 The recommendations for domestic content is being restricted to critical element of the Solar PV systems only and are as follows:

- a. Mandate that for Phase 1 of the Mission, all deployment in grid connected solar power be done using both cells and modules manufactured in India.
- b. In year 2012-13, all installations be mandated to use Power Conditioning Units (PCUs) made in India. This requirement would enable adequate investments in PCUs manufacturing to be made by 2011-12 with international efficiency levels.
- c. A review may be done in 2013-14 to see if the mandate could be extended to wafers and silicon being made in India for the subsequent years.

#### Solar Thermal Systems

4.8 For Solar thermal power projects, it was noted by the Committee that the commercial plants globally have been installed based on two technology

configurations viz. parabolic trough and central tower systems. The key components of the technology are solar receivers, bent glass solar mirrors, and power block. The availability of these components is crucial and shortages cause bottlenecks in the chain. In India, no commercial solar thermal power projects have been installed so far. However, Indian industry is gearing up to explore possibilities of manufacturing various components in view of the National Solar Mission. To begin with, fabrication of some items is possible. From the submissions before the Committee, it appears that there would be economic advantages in manufacturing closer to the deployment sites. The decision to undertake manufacturing would, however, depend on the volume of anticipated business. The scale of the Solar Mission appears large enough for the manufacturers to seriously consider creating the capacity to make the specialized glass, generating turbines, etc. for these projects in India.

4.9 The consensus arrived was to mandate 30% of local content to begin with for all plants in solar thermal technology. The technology providers did present before the Committee that there is a possibility that higher local content was possible in the initial year itself. The Committee, however, was of the opinion that this is a new and emerging technology wherein there are few global players of scale and hence there is a need to prescribe only a modest domestic content requirement so as not to deter or inhibit competitive entry into the Indian market. It is also recommended that the projects of Solar thermal which would be sanctioned in the year 2012-2013 have 50% local content mandated as by then adequate domestic manufacturing capability is expected to emerge. By then a clearer picture would emerge regarding the critical elements of the technology and the potential for their manufacturing in India and based on that assessment phased increase in indigenization could be considered for the subsequent years.

4.10 In view of this, the Committee recommends the following:

- i. Mandate 30% of local content to begin with for all plants in solar thermal technology.
- ii. The projects of Solar thermal which would be sanctioned in the year 2012-2013 have 50% local content mandated.

#### **Encouragement to New and Efficient Technologies**

4.11 The Committee also took note of the fact that since technology is rapidly evolving in the field of Solar PV, there is a need to provide ample opportunity for deployment of the latest technologies, selectively, through projects under the Mission wherein the developers could tie up with proven technology providers/module manufacturers that offer better efficiency and/or technology than what is available and being deployed in India. It is accordingly recommended that the condition of

local content may be relaxed for such projects. The decision to permit the setting up of such plants in India may be taken by an Empowered Committee, after an evaluation of the technology being proposed, for greater efficiency or novelty, holding the promise of cost reduction. Further, its successful field operation for at least two years should be a pre-condition for such projects. The relaxation of domestic content requirement should be such as to provide for deployment of a critical mass in field conditions in India, after which the condition of domestic manufacturing for the new technology/product which is more efficient may be prescribed. This approach is necessary to facilitate the entry of new and more efficient technologies in the country. This would help India move up the technology development curve faster.

4.12 Such an approach for Solar Thermal may be considered in 2012-2013 by when critical elements of Solar Thermal Technology would get identified for domestic manufacturing. Till then, the domestic content requirement that is being mandated is quite modest and in the view of Committee early achievable.

4.13 The Committee also recommends that while stipulating local content requirement, relevant international quality standards be stipulated alongside.

4.14 The Committee further recommends that the prices and supply position in the domestic market be monitored closely and in the event of unreasonable variations in these, the policy may be appropriately reviewed.

**ANNEX.1**

No.5/17/2009-P&C  
Government of India  
Ministry of New and Renewable Energy

\*\*\*

Block No.14, CGO Complex, New Delhi.

Dated the 14<sup>th</sup> December, 2009

**Office Memorandum**

Jawahar Lal Nehru National Solar Mission has recently been approved by the Cabinet and the National Solar Mission Document is available at the Ministry's website. With a view to promote India as a manufacturing hub, a committee has been set up under the Chairmanship of Shri Ajay Shankar, Secretary, Department of Industrial Policy and Promotion, Ministry of Commerce and Industry. The composition of the Committee is as below:-

1. Shri Ajay Shankar, Secretary, Department of Industrial Policy and Promotion, Ministry of Commerce and Industry - CHAIRMAN
2. Adviser, Planning Commission,
3. Director General , Bureau of Energy Efficiency, New Delhi
4. Secretary, Central Electricity Regulatory Commission, New Delhi
5. Chairman and Managing Director, Indian Renewable Energy Development Agency (IREDA), New Delhi
6. Representative of the Central Electricity Authority
7. Representative of National Manufacturing Competitiveness Council (NMCC), New Delhi.
8. Representative of Ministry of Power
9. Representative of NTPC/NTPC Vyapar Vidyut Nigam Ltd (NVVN)
10. Representative of PFC Consulting Limited (PFCCL)
11. Representative of Indian Semiconductor Association

**Setting up of a Committee to recommend policy to encourage Domestic Manufacturing of Solar technologies**

The National Solar Mission has proposed an ambitious target of 20,000 MW of solar power generation in the country by 2022. The Mission has also proposed to set up 4-5 GW equivalent domestic production facility in the country, covering the entire value chain. While solar cells and modules are being manufactured in the country, poly silicon material and various other materials and components for solar photovoltaic manufacture are still being imported. Government is encouraging expansion of solar PV manufacture in the country through Special Incentive Package Policy announced by the Department of Information Technology.

In case of Solar thermal, very limited capabilities exist in the country especially related to industrial process heat system including steam generation, cooling air heating drying. In order to establish India as a solar manufacturing hub, in keeping with the policy intent elucidated in the National Solar Mission, an incentive package would be required

In order to achieve this objective, it is proposed to constitute a Committee, with the following terms of reference:

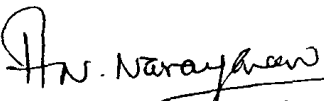
TOR

1. To review the present status of domestic industry, indigenous content and barriers in indigenization and the existing policies and incentives available to the industry.
2. To identify the critical elements/components which lend themselves for indigenous manufacture and cost reduction on account of economies of scale.
3. To recommend policy framework and specifically the incentives and procedures to be adopted to encourage domestic solar thermal industry in the country. SME sector presents a critical interface especially for Balance of systems and should also be considered for appropriate incentives
4. To recommend the minimum indigenous content for solar power projects, both solar thermal and photovoltaics
5. To project the estimated requirement of funds for implementing the above.
6. To recommend policy interventions to encourage domestic production of raw materials and components ( not covered under the SIP policy) required for expanding the domestic industrial base.
7. Any other related matter Committee may like to recommend, keeping in view the policy intent detailed in the National Solar Mission document.

12. Representatives of States of Gujarat, Rajasthan
13. Scientist "F" , MNRE
14. Joint Secretary, MNRE - Convener.

The Terms of Reference of the Committee are enclosed. The Committee can co-opt any other member or experts as considered necessary and also call persons/institutions/associations/entities as special invitees.

The Committee would submit its report in 3 months.

  
(A.N.Narayanan)

Under Secretary to the Government of India

1. Secretary, Department of Industrial Policy and Promotion , Ministry of Commerce and Industry, Udyog Bhavan, New Delhi.
2. Secretary, Ministry of Power, Shram Sakthi Bhavan, Rafi Marg, New Delhi
3. Senior Adviser, Planning Commission, Yojana Bhavan
4. Chairman, Central Electricity Authority, Sewa Bhavan, R.K.Puram, New Delhi.
5. Shri Gaurav Dave, Chief & Joint Secretary, NMCC, Vigyan Bhavan Annexe, New Delhi
6. Shri Ajay Mathur, Director General, Bureau of Energy Efficiency, 4<sup>th</sup> floor, Sewa Bhavan, R.K.Puram, New Delhi .
7. Secretary, Central Electricity Regulatory Commission, 3<sup>rd</sup> and 4<sup>th</sup> floor, Chandernagore Building, 36 Janpath, New Delhi-110001.
8. Shri D. Majumdar, CMD, Indian Renewable Energy Development Agency, 3<sup>rd</sup> floor, August Kranti Bhavan, Bhikaji Cama Place, New Delhi-110066.
9. Chairman and Managing Director, (Shri R.S.Sharma), NTPC Limited, NTPC Bhavan, Scope Complex, Institutional Area, Lodhi Road, New Delhi-3
10. Secretary (Energy) (Shrimat Pandey), Government of Rajasthan, Jaipur -302 001.
11. Secretary (Energy), Government of Gujarat, Gandhinagar.
12. Shri Tyagi, CEO, PFC Consulting Limited, first floor, "Urjanidhi" 1 Barakhmba Lane Connaught Place, New Delhi.
13. Scientist "F", MNRE

Copy to : PSO to Secretary, MNRE

Presentation to the Secretary, DIPP,  
Government of India

Mahindra Partners

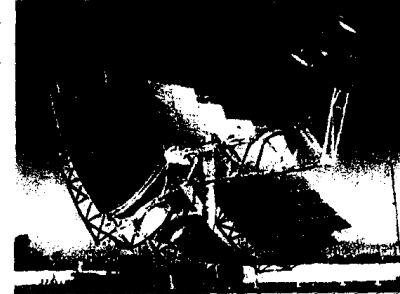
December 23, 2009



**Mahindra**



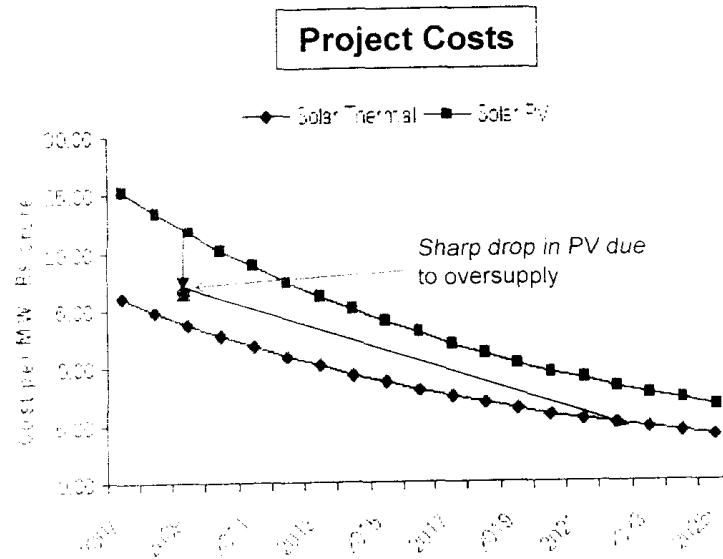
# CSP Technology Options



Key Parameters	Parabolic Trough	Power Tower	Parabolic Dish
Advantages	<ul style="list-style-type: none"> <li>• Most commercially proven</li> <li>• Proven hybrid plant capability</li> <li>• Lower materials requirement</li> <li>• Storage capability</li> </ul>	<ul style="list-style-type: none"> <li>• Higher efficiency</li> <li>• Higher temperature (550-800 C)</li> <li>• Hybrid plant potential</li> <li>• Storage capability</li> </ul>	<ul style="list-style-type: none"> <li>• High efficiency potential</li> <li>• Modularity</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Lower temperature (400 C)</li> <li>• Level land required</li> </ul>	<ul style="list-style-type: none"> <li>• Early stage commercial</li> <li>• Higher maintenance costs</li> </ul>	<ul style="list-style-type: none"> <li>• Complex manufactured systems</li> <li>• No storage possibility</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>• 9 operational plants since 1985 totaling over 350 MW (SEGS I-IX)</li> <li>• 8 additional plants over 300 MW announced (under construction)</li> </ul>	<ul style="list-style-type: none"> <li>• Technical feasibility tested globally between 1981-1986</li> <li>• 2 commercial operational plants totaling 30 MW</li> </ul>	<ul style="list-style-type: none"> <li>• No commercial implementation yet</li> <li>• Development performed mainly in Germany/U.S. developing 3KW, 10KW, and 25 KW systems</li> </ul>

# Cost Projections

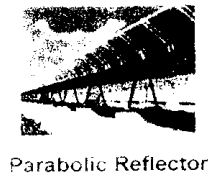
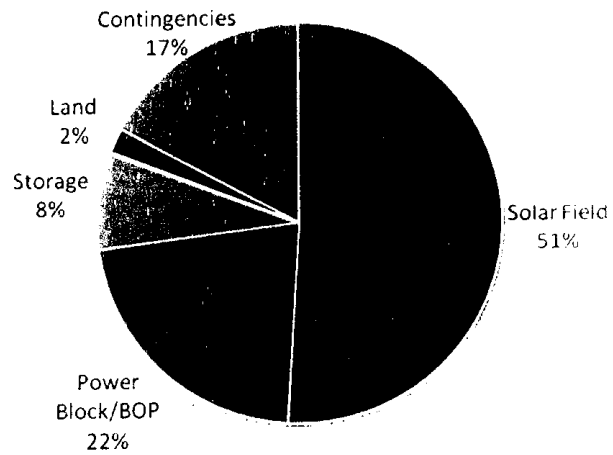
Project Name	Type	Year of Completion	Cost/MW (Rs Crore)
Nevada Solar One	Trough	2007	17.4
Andasol 1 (7.5 hrs storage)	Tower	2008	30.4
PS 10	Tower	2008	26.1
Solana (6hr storage)	Trough	2011	15.12
Ivanpah	Tower	2012	13.9



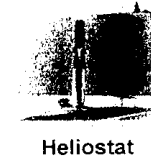
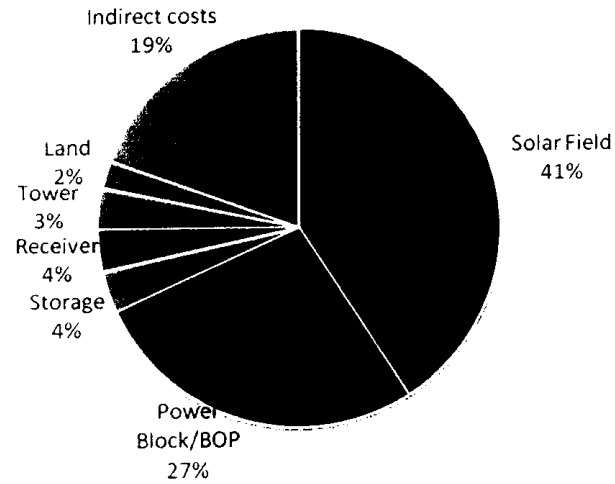
Note: CERC data matches the values above

# Approximate Cost Breakup

## Parabolic Trough



## Power Tower



# Cost Reduction Roadmap

<u>Target Areas</u>	<u>Parabolic Trough</u>	<u>Power Tower</u>
Supply Chain	Parabolic Collectors Reflectors Flabeg Support Structure Mahindra/ JV Receiver Tubes Schott	Parabolic Collectors Heliostats TBD Support Structure Mahindra/ JV Receiver Tower Mahindra/ JV
Scale	Tracking System Drives Mahindra/ JV Sensors Mahindra/ JV Controls Mahindra/ JV	Tracking Sys Drives Mahindra/ JV Sensors Mahindra/ JV Controls Mahindra/ JV
Construction Efficiencies		



# Mahindra Systech: Art to Part

## Mahindra Systech

### Engineering Services

#### Automotive & General Engineering -

- \* Mahindra Engineering Services Ltd
- Engines Engineering S.r.l

#### Aerospace -

- \* Mahindra Aerospace

### Automotive Components Business Unit

#### Forging -

- \* Mahindra Forging (India & Europe)

#### Steel -

- \* Musco Steel

#### Stamping -

- \* Musco Stamping

#### Composites -

- \* Mahindra Composites

#### Gears -

- \* Mahindra SAR & Metalcastello S.r.l

#### Castings & Ferrites -

- \* Mahindra Minoday

#### Telematics -

- \* Mahindra Telematics

### Strategic Sourcing Business Unit

#### Sourcing from LCC countries like India, Thailand, China Etc

Specialized Steel sourcing

Motion and Sensor Assemblies

Drives and Control Units

# Design to Delivery !!!



Mahindra Systech

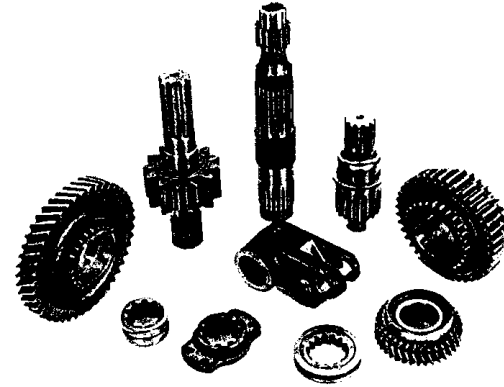
28

# Key Components

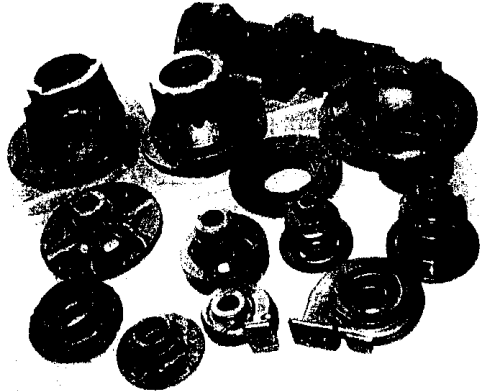
## Forgings



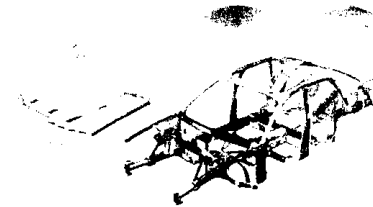
## Gears



## Castings



## Stampings/ Fabrication

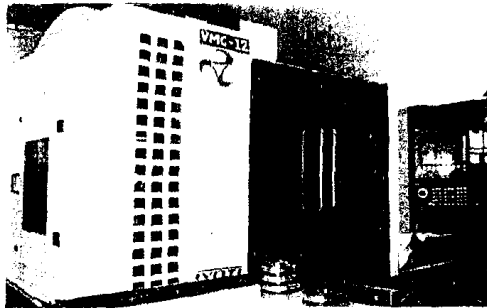
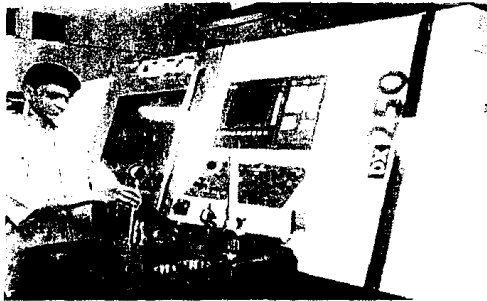


Sheet Aluminum  
Extrusions  
Node Castings



# Our Manufacturing Capabilities

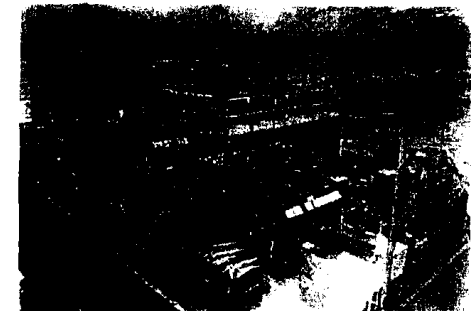
## Gears



## Castings



## Stampings



# Commercial and Supply Chain Strengths

## Strengths Commercial

- Globally reputed brand name & history of successful JVs
- Leadership position in infrastructure development
  - Developed first corporate SEZ in India and first privatized water project in India
  - Experience in Land acquisition, development & maintenance and permits (Mahindra World Cities)
  - Strong Construction Management
- Extensive dealer distribution network in key solar states
- Strong relationships with financial sector/institutions (Indian & Global)

## Supply Chain

- Committed to developing synergistic supply chain for solar power
- Suppliers under evaluation for PV and Thermal Solar Systems
- R&D, Design, Rapid prototyping and specialized processing capabilities
- Specialized Steel sourcing expertise
- "Frugal Engineering" Culture







Thank You





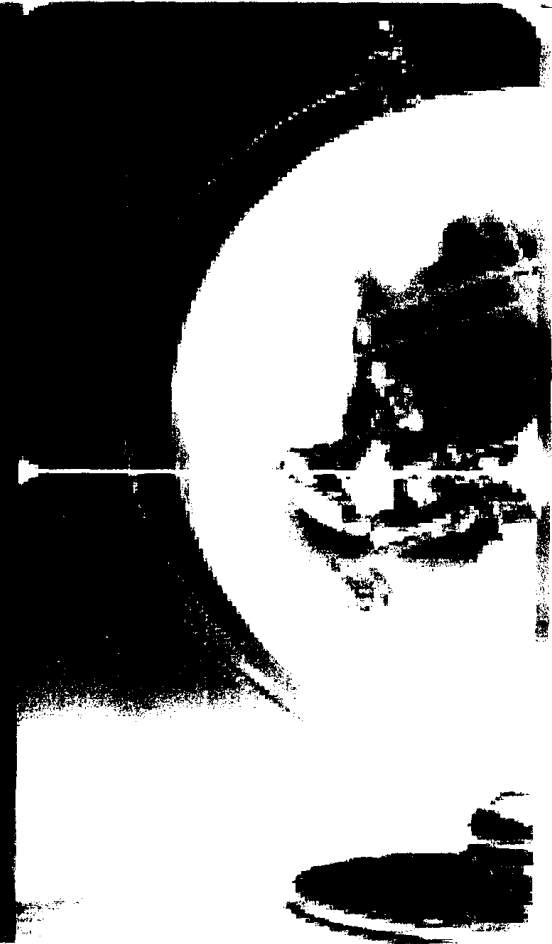
Leading Through Innovation

# Solar Thermal Manufacturing

by

# ACME

23<sup>rd</sup> Dec 2009



## Solar in India



- Solar Mission announced Nov – great step forward – ahead of many countries
  - 20000MW by 2020
  - Both grid and off grid applications
  - Potential to enhance energy security /support Climate change targets and build a global industry
- Both CSP and PV have a place in the sun, but also have similar challenges
  - Not 24 hours
  - Dependent on weather conditions
  - 3 to 4 x grid cost currently to install
- CSP highly suitable for Indian conditions
  - Large scale generation at scale
  - Higher PLF than other technologies – excess of 20%
  - Storage and hybridization capabilities – resolution of the 24 hour issue
  - Likely to reach grid parity earlier- scale dependent

**We need to be more aggressive in this space in India**

# Our Partnership with eSolar



- ACME Group will develop 1 GW of solar generating capacity in India using eSolar technology as an exclusive master licensee
- ACME has invested \$30M equity investment in eSolar
- ACME plans to develop power plants as well as license technology to other developers in India and globally

## FORTUNE

MARCH 2, 2009

### India inks exclusive solar deal

California startup eSolar said on Tuesday that it has licensed its solar power technology for the construction of up to 1 gigawatt of solar farms in India over the next decade.

The deal with Indian conglomerate ACME Group marks India's first move into large-scale solar power and is the biggest announced foray of a United States solar power plant company overseas. The agreement calls for ACME, based in the northern Indian state of Haryana, to invest \$30 million in eSolar, which will also earn fees for each of its 46-megawatt modular solar thermal power plants that are built.

A gigawatt, or 1,000 megawatts, of solar energy produces enough electricity to keep the lights on in about 750,000 energy-hogging U.S. homes. Presumably, many more homes and businesses can be powered by a gigawatt in India, where electricity shortages are common and the country relies on greenhouse-gas emitting diesel generators.



Leading Through Innovation

# Solar Taxonomy

Non-concentrating

Concentrating

Photovoltaic

Solar Thermal

It's the European companies that have become global

Silicon Panels

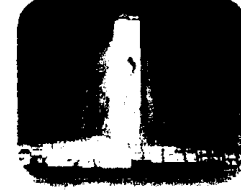
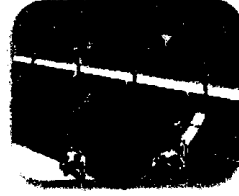
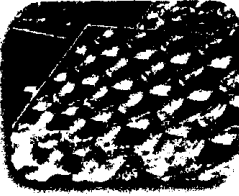
Thin Film Panels

Concentrated PV Panels

Parabolic Trough

Linear Fresnel

Power Tower



SHARP

First Solar

Energy Innovations

SOLEL

ausra

eSolar

SUNPOWER

nanosolar

AMONIX

Acciona

SIAN

BrightSource

SUNTECH

HelioVolt

SolarWorld

ABENGOA

ABENGOA

TOPCEL

SOLYNDRA

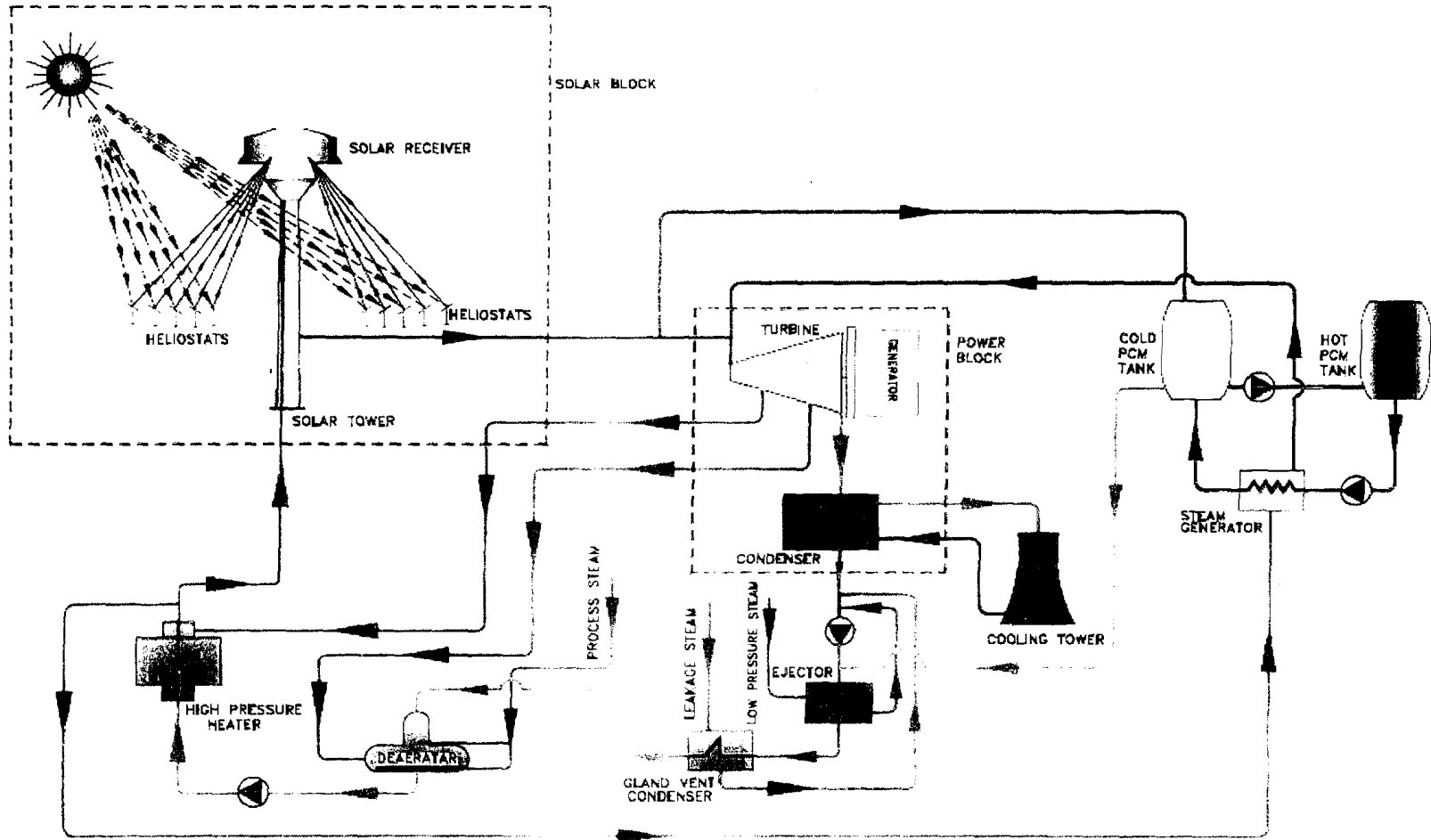
CONCENTRIX

ABENGOA

SkyFuel

ABENGOA

# About Solar Thermal Tower Technology

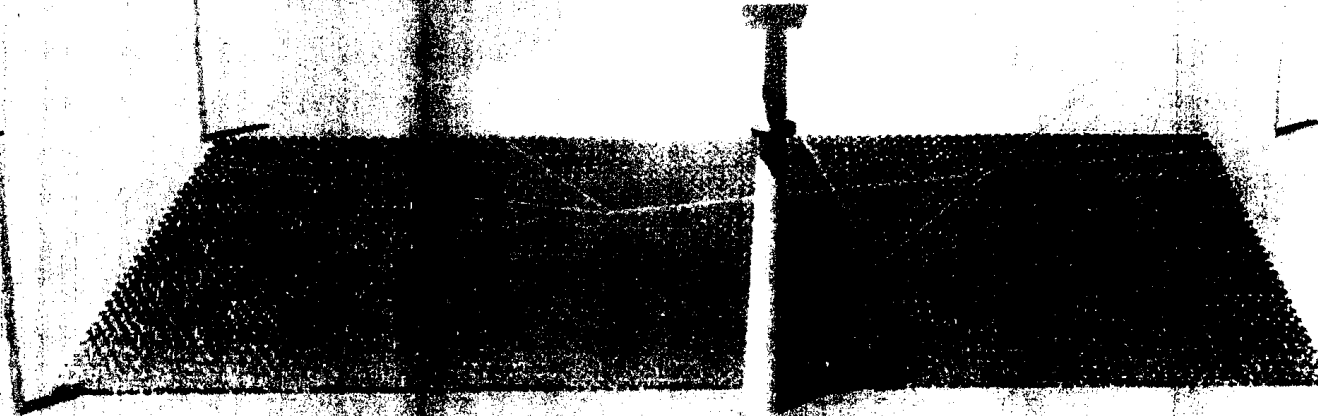


37

## Innovations at the core of AEM's low cost solution



- **Very Precise Pointing with Automatic Calibration**
- Software allows high concentration even in difficult conditions
- Simulation of the parabolic flow using sophisticated IT
- Sophisticated IT removes complexity of making parabolas
- **Higher temp for direct steam conversion**
- **Higher energy output available**



38

# HelioStat assembly



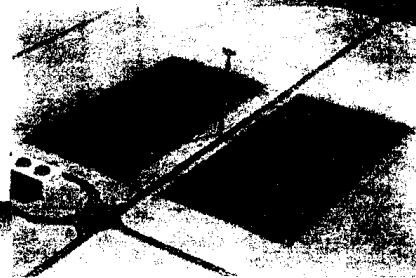
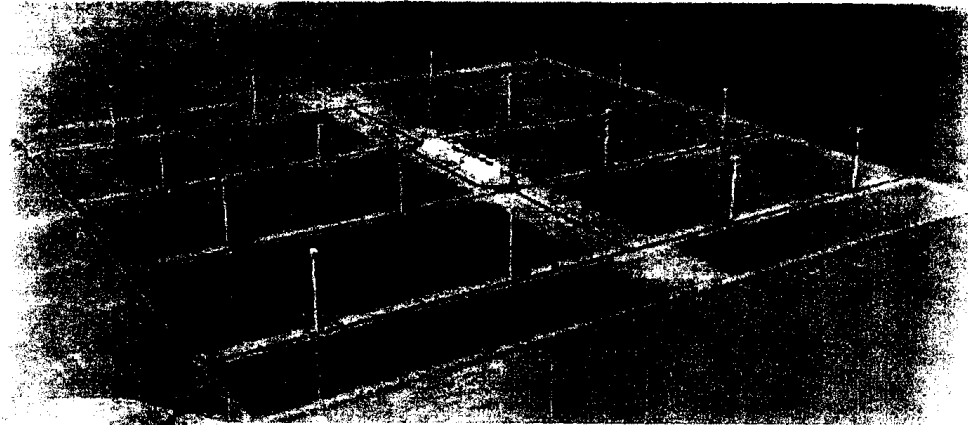


# ACME's pre-fabricated, scalable architecture



Products that are:

- Modular
- Pre-fabricated
- Dramatically less expensive



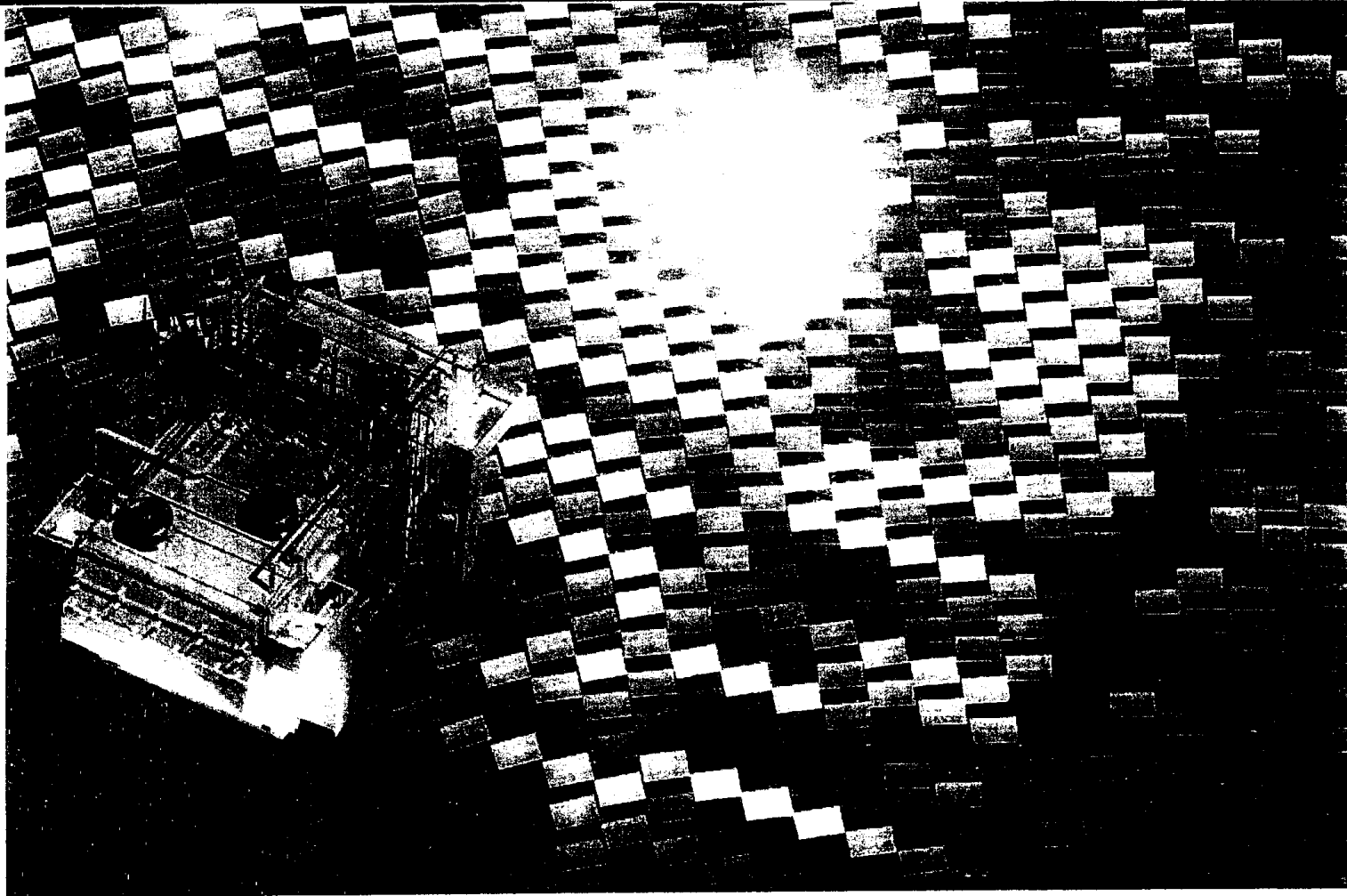
**Unit**  
16 Modules  
**Output: 46 MW**



**Module**  
One tower +  
receiver



**Stick  
Assembly**

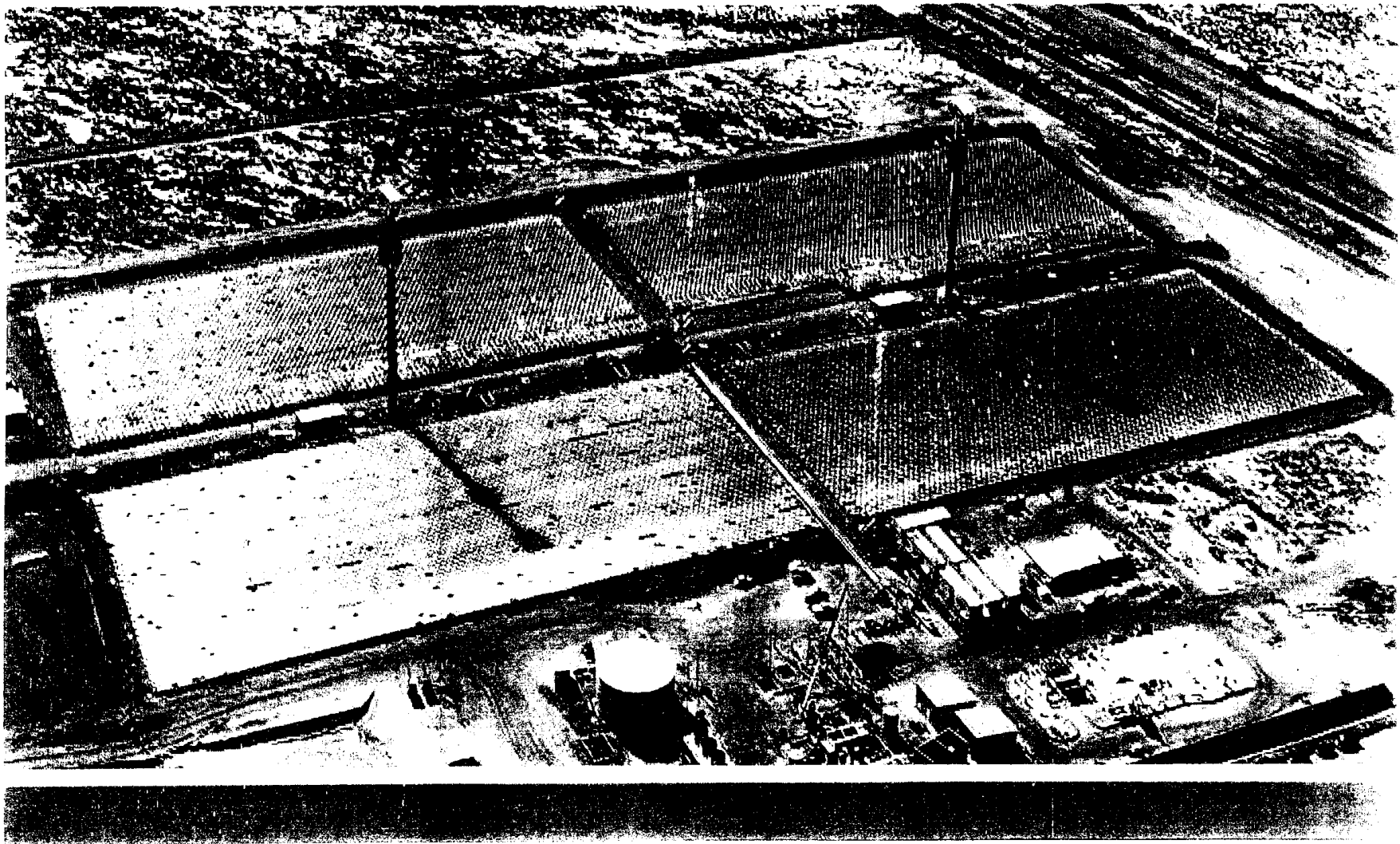


17

# Sun on the Receiver



# Arial view of the 10 MW facility



## Solar Thermal : Globally promising technology

- 1200 MW of Solar Thermal capacity already under construction
- 13900 MW of Solar Thermal projects announced for 2014
- Wide array of operational international installations:
  - Solar Energy Generation Systems plant, USA (354 MW)
  - Nevada Solar One, USA (50 MW)
  - Andasol 1, Spain (50 MW)
  - PS20, Spain (20 MW)
  - PS10, Spain (11 MW)
- 3 World bank projects for Solar Thermal approved in Egypt, Morocco and Mexico

# Strategic Analysis: Solar Thermal



Parameter	Solar Thermal
Manufacturing Potential	<ul style="list-style-type: none"> <li>• Manufacturing facility for all components exist in India</li> <li>• Only incremental investment. Boilers, Mirrors, Turbines, Towers</li> <li>• Huge boost to SMEs</li> </ul>
Raw material	No raw material imported, as opposed to other solar technologies - <b>Total energy security</b>
Job Creation	<ul style="list-style-type: none"> <li>• Highly labor intensive</li> <li>• Creation of huge direct and indirect employment</li> <li>• Solar Thermal plants create 2.5 times as many skilled high paying jobs as other conventional power plants</li> </ul> <p><small>(Source: Pilkington Solar Intl GMBH)</small></p>
Efficiency	Greater than 24% (Higher than other commercially available Solar technology)
Allied beneficiary industries	Steel, Glass, Software, Tools, Construction, Mining, Heavy equipment

45

Copyright © 2010 ACME Solar Thermal

# Solar Thermal Equipments Manufacturing Capacity

Component	Suppliers Identified	Manufacturing capacity
Solar Block		
Mirror (15%)	Indian and MNC majors	<ul style="list-style-type: none"> <li>- 6 months delivery period</li> <li>- Any capacity can be made available</li> </ul>
Boiler (35%)	Many local small & medium industries. 2 manufacturers established	<ul style="list-style-type: none"> <li>- 6 months delivery period</li> <li>- Capacity can be ramped up as required</li> </ul>
Tracking system (30%)	Hardware components comprise of stepper motor, gears & sheet steel work	<ul style="list-style-type: none"> <li>- Manufacturing facility under development in India</li> </ul>
Tower (10%)	Many local small & medium industries	<ul style="list-style-type: none"> <li>- 3 months delivery period</li> <li>- Large production capacity in India</li> </ul>
Power Block		
Turbine (30%)	Maxwatt, Turbotech, Triveni, BHEL, Siemens etc	<ul style="list-style-type: none"> <li>- Multiple units with 6-12 months delivery time</li> <li>- Capacity enhancement as required</li> </ul>
Electrical & Delivery system (20%)	Several MNC's and Indian suppliers available	<ul style="list-style-type: none"> <li>- Adequate manufacturing capacity available</li> </ul>
Piping, controls, cables (15%)	Components used in conventional power plants	<ul style="list-style-type: none"> <li>- Facilities already existent in India</li> </ul>
Cooling Tower & chemical plants	Local SMEs, Gammon, Paltech, Paharpur	<ul style="list-style-type: none"> <li>- 5 to 50 MW modules with 6-8 months for commissioning</li> </ul>

## Value addition & Technology tie-ups



ACME has already tied-up with leading technology provider eSolar for solar thermal projects

ACME is the exclusive holder of eSolar technology in India which is credible, scalable, and most cost effective

ACME is in possession of complete know-how for development and manufacturing of the critical solar plant components pertaining to eSolar technology

Local manufacturers have only to create/align their facilities for ACME technology for manufacturing of these components, design and drawing of which is to be provided by ACME

For establishing the manufacturing facilities and indigenization of all the critical solar field components, ACME will require mandate of at least 500 MW to achieve economy of scale and for indigenizing all the manufacturing facilities

After achieving the economy of scale and indigenizing the critical solar field components, cost of solar thermal power plants delivered by ACME is expected to come down substantially, i.e., below Rs. 10 crores/MW level

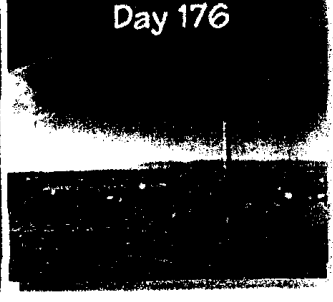
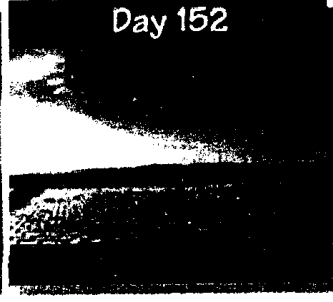
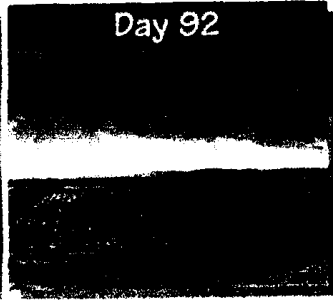
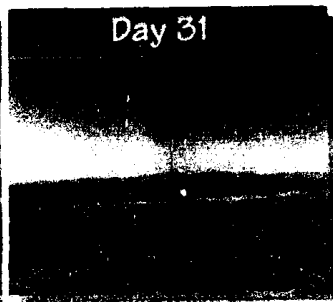
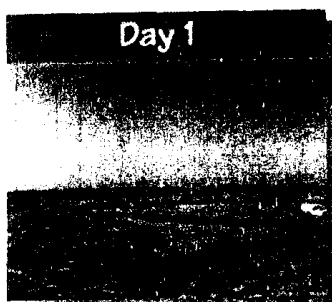
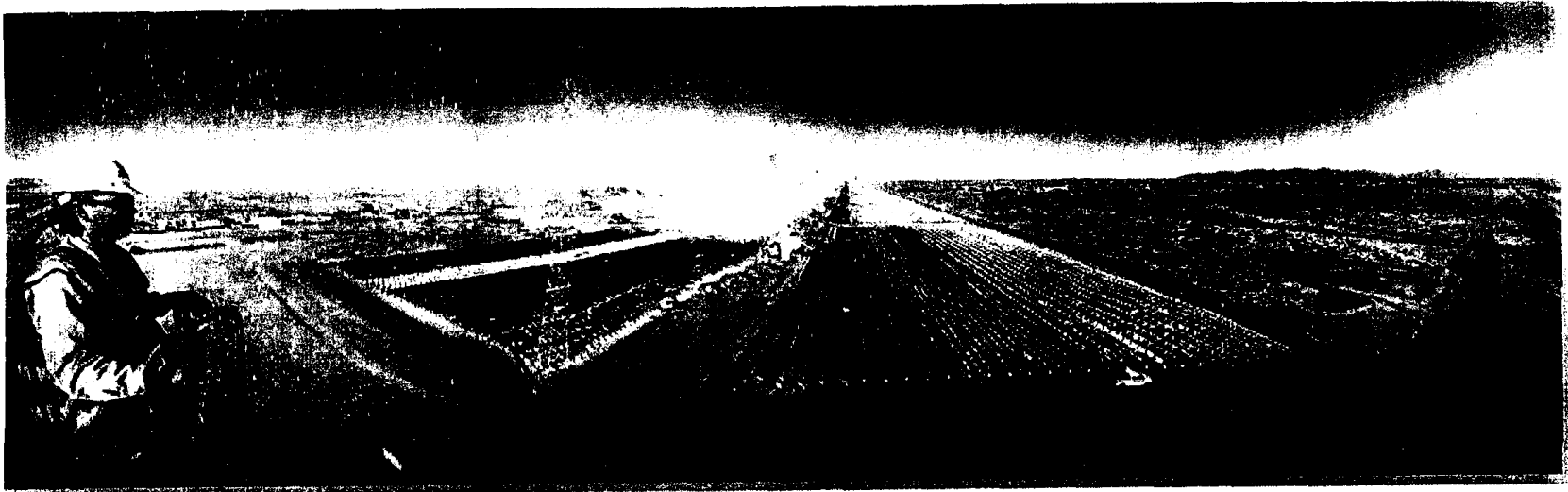
Power block components and power delivery system are already being sourced indigenously



# Project Implementation



24,000 mirrors, 2 towers, one power block



48

# Solar Thermal: Wide application areas

## Large scale applications

Large scale centralized power generation

Large scale hybrid plant with gas

Storage applications – early days

Peak power applications

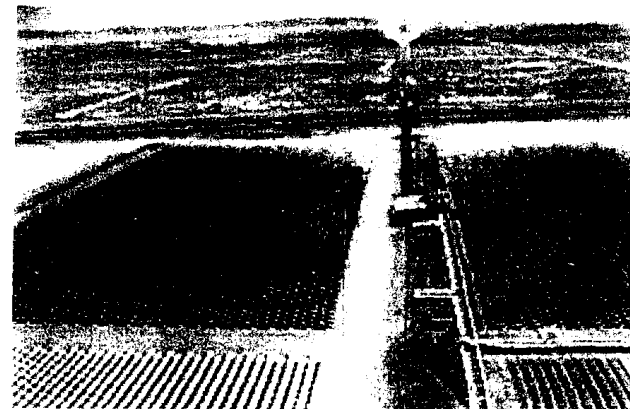
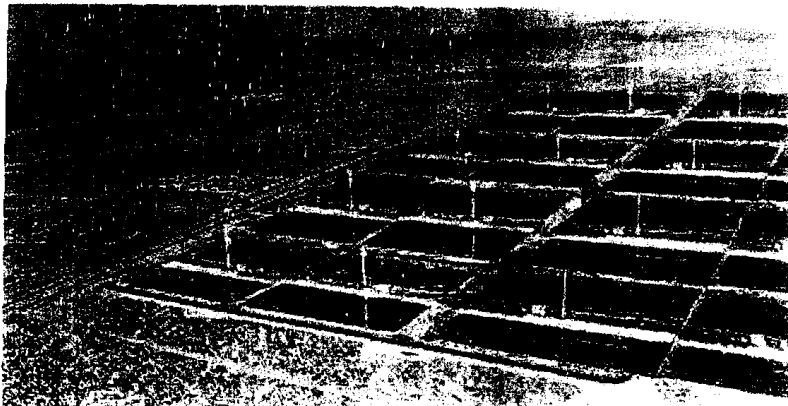
## Distributed generation

-Distributed rural electrification (2.5 MW)

Steam generation to replace coal boiler for textile mills and large industries

Central cooling (1000 to 5000 tonnes)

Micro Solar Thermal



## Issues & Support required from Government



Mission announced but need clarity on Rules for implementation of existing and new projects by NVVN

Transition of existing projects from states and MNRE schemes

Normative tariff upto 31/3/2010 based on capex and PLF norms makes CSP currently unviable .

Projects implementation needs 2 to 3 year tariffs for getting PPA signed and projects funded

Tax parity: Tax exemption announced in mission to be notified

Should be 2.5% like UMPP recently announced if not zero

2000 MW for Phase 1 is low – needs to be higher to get scale to kick-start component and equipment manufacturing in India

SEZ type solar parks



Thank You

51

# **Suggestions to increase domestic content in solar installations under National Solar Mission**

Feb 3<sup>rd</sup>, 2010

## Solar in India

- National Solar Mission announced - Goal to have 20,000 MW of capacity online by 2022 – Government incentives of ~ \$ 25 Bn.
- Key deliverables of the Mission
  - Proliferate Solar Power generation in India
  - Reduce cost of solar energy in India
  - Enhance domestic manufacturing & create domestic competencies solar in India
  - Promote R&D and technology development within India
  - Maximizing job creation opportunities in India
- Solar PV today is expensive and hence it is being subsidized by Indian consumers / taxpayers. Government needs to ensure that the **value of this subsidy is retained & redeployed in India** as is currently being done in several countries across the world



**Create Domestic Eco- System for Solar in India**

## Solar PV - Value Addition

	Crystalline Silicon	Thin Film
Metallurgical Grade Silicon	0.3%	
Polysilicon	9%	
Wafer	12%	
Cell	21%	
Module	18%	55%
Inverter	7.6%	8%
Mounting Structures	8%	10%
Wiring and Electricals including Power Evacuation	11%	12%
Construction Cost including System Integration	13%	15%
<b>Total</b>	<b>100%</b>	<b>100%</b>

54

## Domestic Content Requirement for Migration Projects

- Currently, India has around 700 MW of solar manufacturing capacity. However, a bulk of this high quality manufacturing is being exported as there is very limited market in India. Domestic content requirement, as is followed in other countries, will ensure high quality equipment will be absorbed in India
  - We need a solution which says **"Made in India, for India"**
  
- PV is relatively new in India & it is imperative for all stakeholders to get familiar with high quality systems installed using Indian components. Poor quality & cheap imports will kill the industry in its infancy
  - PPAs need high quality panels with 25 year product warranty else may not be bankable
  - Systems need to be set up using high quality components. Poor quality products will not last for that long and system failure might raise questions on the viability of the technology thereby precluding access to project finance for the industry
  
- Domestic Content requirement will also promote foreign investment by enabling companies to set up manufacturing base
  - Samsung has signed a \$6.6 Bn deal with the Canadian government wherein to build 2,500 MW of Wind & Solar power projects, by establishing manufacturing facilities that will build the necessary equipment



## Domestic Content Requirement for Migration Projects

- Indian conditions are very different from international conditions, thereby resulting in varying energy yields.
  - Industry needs to collect enough on-ground performance data in Indian conditions, using Indian equipment so that adoption in entire stakeholder community is accelerated
- R&D is a critical component of the NAPCC. Industry needs to ensure that bulk of the R&D initiatives are undertaken on Indian equipment to ensure IP protection

## **Indian Panels - Competing on a global platform**

- Indian panels are amongst the best in the world
  - Offer **25 year performance warranty** with comprehensive warranty coverage backed by global insurance firms
  - Offer **high quality & reliability** – Comprehensive reliability testing, ISO 9001 & 14001, SA 8000 compliant
  - Meet all **international certifications** such as IEC, TUV, CE, UL
  - **Bankable performance** – Projects financed by large global banks for various types of installations on different surfaces
  - **Track record** of successful performance in varying weather conditions
  - **Globally cost competitive** – Successfully capturing market share amongst leading manufacturers from across the globe

## **Suggested Domestic Content Process Requirements**

- Panel manufacturers to apply to MNRE for registration. Certification to be based on.
  - Capacity
  - Panel Quality / Certification as suggested by MNRE
- Except for Inverter manufacturing, India has an established manufacturing base for all other parts of the value chain. Award of projects to be based on presence of domestic content and preference will be given to projects having higher domestic content.
- Project developer to submit along with proposal, certificate from panel manufacturer certifying the capacities allotted for this project
- MNRE to ensure that domestic capacity is not over-allocated. If a particular manufacturer over-allocates domestic capacity, his certification with MNRE to be cancelled.
- MNRE, at the time of grid connection, to ensure that proposed panels and technology used in the farms are actually those that were given at the time of project proposal
- Projects with domestic content to be given preference while selecting projects including transition projects

## Domestic Content Requirement – Global Examples

### “US Domestic Content” provision

American Recovery & Reinvestment Act of 2009 includes significant incentives which are applicable only if goods used in the project are produced in the US

- Production Tax Credit : \$13.1 Bn
- Modified existing Energy Credit : \$2.3 Bn
- Energy Efficiency & Conservation Block Grant : \$3.2 Bn
- State Energy Program : \$3.1 Bn
- Energy Efficiency & Renewable Efficiency R&D Demonstration & Deployment : \$2.5 Bn

### Chinese Domestic Content Provision

- Economic stimulus package is accessible only to those projects that purchase domestic products

### Australian Domestic Content Provision

Merit will be awarded to *projects* that include a greater portion of Australian industry participation, including small and medium sized enterprises, throughout the *project* value chain. Merit may be demonstrated by

- a) providing a clear and comprehensive Australian industry engagement strategy, outlining how the *applicant* plans to:
  - (i) maximise Australian industry involvement in the *project*;
  - (ii) expand real and sustainable employment opportunities in the Australian solar industry;
- b) documentary evidence of agreements with suppliers and subcontractors to provide Australian sourced *project* goods and services

**DOMESTIC CONTENT REQUIREMENT - GLOBAL EXAMPLES**

"Buy Canadian" provision

Solar Projects over 10kW		Solar Projects under 10kW	
Minimum Domestic Content Level	Year of Commercial operation	Minimum Domestic Content Level	Year of Commercial operation
50%	2009 TO 2010	40%	2009 TO 2010
60%	2011 and later	60%	2011 and later

Calculate Domestic Content Requirement		
Designated Activity	OPA Definitions	Qualifying %
<b>Silicon</b>	Silicon that has been used as input to solar photovoltaic cells manufactured in an Ontario refinery.	10%
<b>Ingots &amp; Wafers</b>	Silicon ingots and wafer, where silicon ingots have been cast in Ontario, and wafers have been cut from the casting by a saw in Ontario	12%
<b>Solar Cells</b>	The crystalline silicon solar photovoltaic cells, where their active photovoltaic layer(s) have been formed in Ontario	10%
<b>Solar Modules</b>	Solar photovoltaic modules (i.e. panels) - where the electrical connections between the solar cells have been made in Ontario, and the solar photovoltaic module materials have been encapsulated in Ontario	13%
<b>Inverter</b>	Inverter - where the assembly, final wiring and testing is done in Ontario	9%
<b>Mounting Systems</b>	Mounting systems - where the structural components of the fixed or moving mounting systems are entirely machined, formed or cast in Ontario. The metal for the structural components may not be pre-machined outside Ontario, other than peeling/roughing the part for quality control purposes when it leaves the smelter or forge. The machining and assembly of the mounting system must entirely take place in Ontario (bending, welding, piercing and bolting).	9%
<b>Electrical Wiring</b>	Wiring and electrical hardware that is not part of other designated activities (i.e., items 1, 2, 3, and 5 of this table), sourced from an Ontario supplier	10%
<b>Labour</b>	All on- and off-site labour and services. For greater certainty, this Designated Activity shall apply in respect of all Contract Facilities	27%
<b>Total</b>		<b>100%</b>

69

**Sub : Safeguarding interest of domestic manufacturers**

The announcement of the Mission Document by the National Solar Mission unveiling the roadmap for capacity addition of solar based electricity is a laudable initiative.

However, we are concerned that this should not lead to supply of cheap and low quality modules and other products used in solar PV industry from other geographies which could affect our domestic manufacturing industry. In this regard, we propose the following suggestions to the Govt. We feel that these suggestions are in compliance with WTO guidelines.

**1. Encourage sourcing of Made in India products for Govt programmes / projects**

We should encourage the production of "Made in India" products by giving the domestic manufacturers preferential market access / reserving a particular share in the market for Indian products. This can be achieved in the following manner:

- ▶ Recommend 30% of the demand must be met by products made in India if they are technically and commercially competitive for government procurement.
- ▶ Using / sourcing products made in India to execute national projects

**2. Promoting higher domestic value addition**

Domestic content requirement / value addition should be encouraged and attaining certain levels should be made a criteria prior to award of contracts. Specifying 30% value addition for foreign investment in a specific technology if products made in India do not exist in a specific technology area Accordingly, the Government should insure that each facility utilizing any form of solar technology including solar PV should achieve a minimum percentage for the domestic content level which can be set out prior to award of any contracts. The proposals in this regard are given below:-

- i) The domestic content requirement (DCR) can vary as a function of the size of the system and the time of commission of the power plant. For instance,
  - a. For projects with capacity less than 10KW, the domestic content requirement (DCR) can be ~40% for projects commissioned before December 31<sup>st</sup>, 2011 and DCR can be increased to ~50% for projects commissioned after December 31<sup>st</sup>, 2011.
  - b. For projects with capacity greater than 10KW, the DCR can be ~50% for projects commissioned before December 31<sup>st</sup>, 2011 and DCR can be increased to ~60% for projects commissioned after December 31<sup>st</sup>, 2011.

- c. The above percentages may be increased in subsequent phases of the Nation Solar Mission program with the development of local manufacturing capabilities within the country.
- ii) The domestic content level can be calculated and monitored in accordance with the methodologies set out in the detailed Nation Solar Mission program rules where each "designated activity" that has been performed with respect to any solar facility is allocated a specific "qualifying percentage". Please refer to the table in the Annexure enclosed which contains the proposed DCR levels for c-Si based cells / modules. The norms for thin film based cells / modules could also be developed accordingly.
- iii) Specifying 30% value addition for foreign investment in a specific technology if products made in India do not exist in a specific technology area.
- iv) It is recommended that project developer submits a plan in a prescribed form setting out how the developer intends to meet the domestic content requirement levels which must be used mandatorily for evaluation of projects. This must be approved by the designated authority before the project gets the go ahead. Projects not meeting the domestic content requirement levels must not be considered for development.
- v) Following the completion and commissioning of the projects, developers may submit a domestic content report setting out each designated activity that has been performed in India. The supplier should provide in this report documented evidence that the designated activity was performed in India with respect to the project facility. This must be approved by the designated authority.

### **3. Rationalisation of duty structures**

Under the existing duty structures, the solar cells and modules attract NIL customs duty, while the inputs which go into their manufacturing (like EVA, Tedlar, Toughened Glass) attract duty of 12.83%. This results in an inverted duty structure which favours the importers of the cells / modules and puts the domestic manufacturers to a tremendous disadvantage. As other infrastructure inputs like power and financing cost are already higher in India vis-a-vis other countries, the inverted duty structure further increases the cost of the domestic manufactured cells and modules and makes them less cost competitive vis-a-vis the global players. It is, therefore, proposed that the inverted duty structure should be corrected.

Annexure

**Proposed domestic content level for various activities  
(for c-Si based cells / modules)**

S.no	Designated Activity	Qualifying %
1	Silicon used for manufacture of Solar Cells manufactured in India	10%
2	Silicon ingots and wafers used where ingots have been cast and wafers have been cut from the cast by a saw in India	10%
3	The PV Solar Cell where active PV layer is formed in India	15%
4	SPV modules where the electrical interconnections between cells have been made in India and solar module material has been encapsulated in India	20%
5	Inverters, where assembly, final wiring and testing has been done in India	5%
6	Mounting systems, where the structural components have been machined or formed or cast in India	10%
7	Wiring and Electrical hardware	10%
8	Construction cost and on site labour performed by residents of India provided no more than 5% of the total person-hours of all such labour is performed by individuals who are not Indian Nationals	5%
9	Consulting services including legal, technical, accounting performed by residents in India provided no more than 5% of the total person-hours of all such labour is performed by individuals who are not Indian Nationals	5%
<b>Total</b>		<b>100%</b>



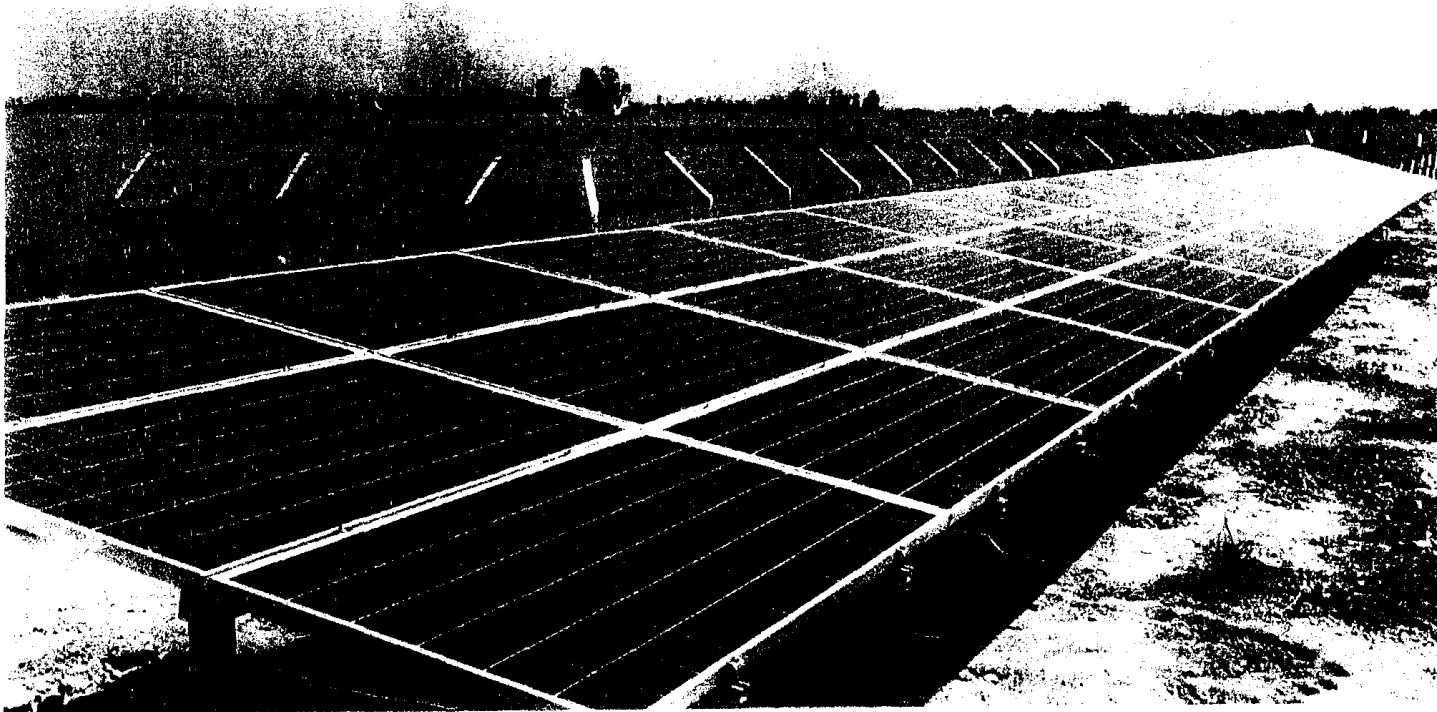
Clean energy for better tomorrow...

Azure Power

## Azure Power LCR Update (MNRE)

Feb 3, 2010

Inderpreet Wadhwa, CEO, Azure Power



### India's First Private MW Scale Solar Power Plant (BOO)

Location of photo: Awan, Amritsar, Punjab

## *Key Objective for Solar IPPs/Developers*

Build, Own and Operate highest performing solar generating assets at lowest possible cost thru...

Sustainable policy regime to grid parity

Technology focus (increase performance, reduce capex)

Project financing

EPC and O&M Excellence

## Technology from a developer's eye in 2010 (PV)

### Performance

Utility Grade Technology (240W+ crystalline, 100W+ thin)

Plus Tolerance

7-10 years track record

Demonstrated R&D for high performance and lower costs

### Bankability and Financing

Generation Guarantees 90% 12 years, 80% 25 years

Bankable Guarantees through Insurance

Reference Utility Sites running for the loan tenure

Long tenure concessional financing (development banks)

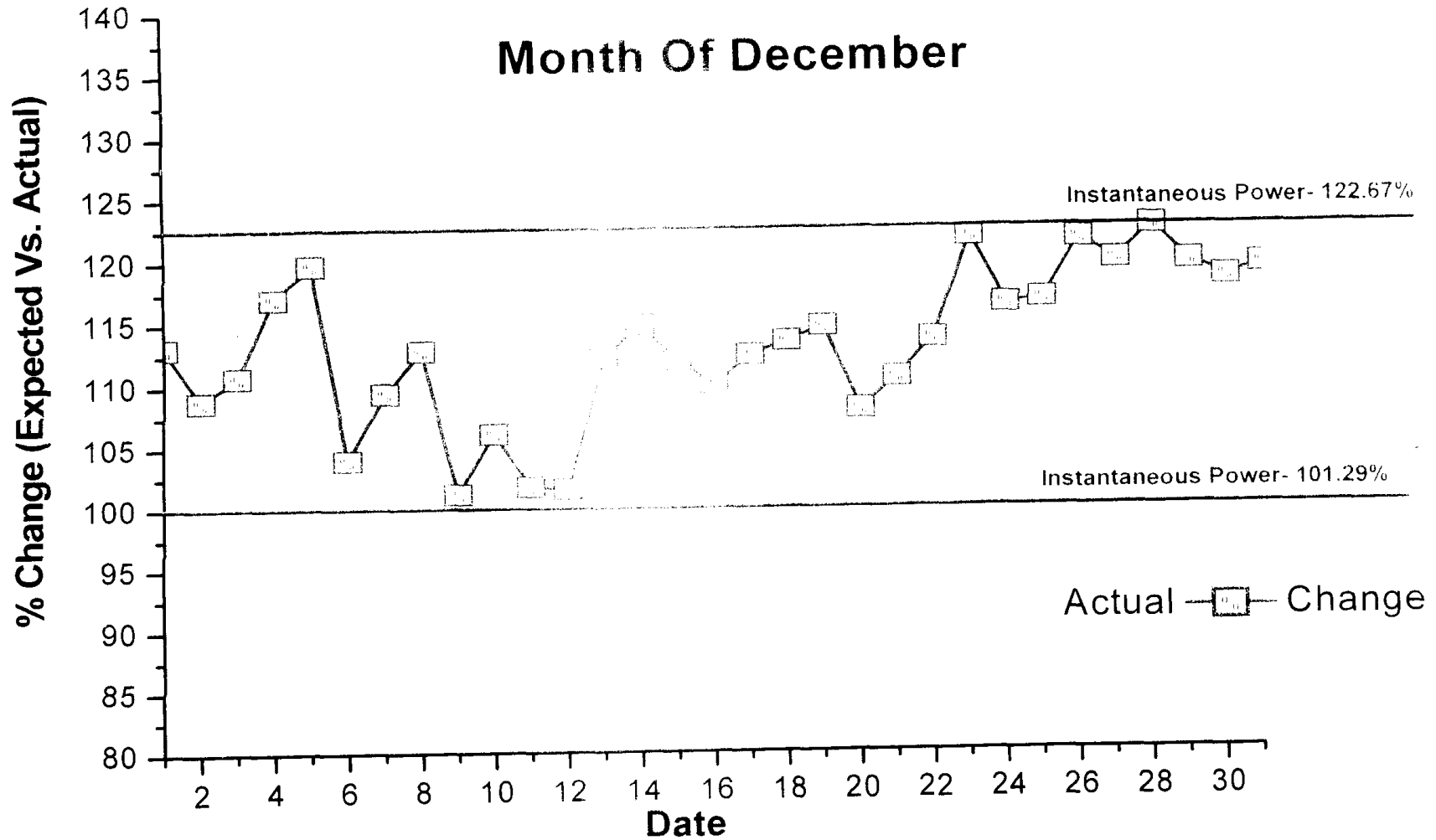
### Price

\$1.75/W Delivered

4-6 month payment terms

# Plant Performance over PPA term

Intermittent Power  
Output  
Active Power



Considering the Actual Weather conditions, we have produced **101% to 122%** more power than the expected power output from the project site at Awan, Punjab.

# Representative Content Composition

27 MW Power

	% Composition
Building & infrastructure	1%
Project development	2%
Plant construction	5%
Modules	59%
Inverters	10%
Mounting structures	11%
Other plant equipment	11%
Office equipment	0%
<b>Total</b>	<b>100%</b>

- Inverters and Modules make approximately 70% Content
- Other plant equipment is 22%
- Non equipment content is approx 8%
- There is limited availability of inverters, high power DC cables locally
- Essentially the LCR of over 20% implies module purchase locally

### Phased Indigenization

Let there be choice of technology to build initial capacity/market (say 500MW)

Government Agencies such as NTPC (350MW), KPCL could off take available indigenized supply

Private IPP players to have the choice to proceed with bankable technology yielding highest IRR, which could be local

Concessional financing by IREDA/PFC for LC projects

Start with 10% in phase 1, 30% in phase 2, 50% in phase 3

Market dynamics will lead to higher LC by 2013

Local content should compete on performance, bankability and price

# Azure Power

Supplying Water Energy Services for utilities and commercial sites

The IPCC has predicted an average global rise in temp of 1.4 C ( 2.5 F ) to 5.8 C ( 10.4 F ) between 1990 and 2100

## Contact Information

A-11 Second Floor, Kailash Colony, New Delhi, India Tel +91 9999800090

70

Subject Solar Developers and Manufactures Meeting  
 From Subramaniam Vara <varassubra@gmail.com>  
 Date Saturday, January 30, 2010 12:11 pm  
 To an.narayanan@nic.in  
 Cc Anil Lakhina <anil@lakhina.com> , Aseem sharma <aseem.sharma@sunborneenergy.com> ,  
 Varun Aggarwal <trulyvarun@gmail.com>

Dear Mr AN Narayanan,

Thank you for your mail inviting the Solar Developers and Manufacturers for a meeting at MNRE on 03 feb 2010 to examine the way ahead for indigenisation for CSP's.

As i would away from the country, i am forwarding my comments for consideration.

As per our interaction on the level of indigenization, please find attached below our observations.. The actual capacity addition would be increasing only from 2013 as during 2010 National Solar Mission is refined and project approvals / registrations are done, achieving financial closure and initiating projects implementation may pick up by Oct-Dec- 2010 - and Jan-Mar 2011. Considering high investments, 20-24 months for implementation of CSPs, limitations of supplies of critical components, we have indicated the following:

Year	Capacity of CSP installations adequate to bring more indigenization	Level of Indigenization	Major imported items	Major items available indigenously	Remarks
2010	[do not foresee any capacity addition during 2010 ]	25%	Mirrors, vacuum tubes for Solar field, and HTF	Boiler /Heat exchangers,Turbine Generator, Balance of Plant, Steel support structures for the solar field.	As approvals were accorded only in Oct'09. The cost per MW and tariff issue to be resolved at the earliest to avoid time delay. The sooner the capacity addition , the better the chance for achieving cost reductions.
2011	100 MW	40-50%	Mirrors, vacuum tubes, Solar field, HTF	Boiler Turbine Generator, Balance of Plant, Heat Exchanger. Steel support structures for the solar field.	Gujarat/ Rajasthan/ MNRE GBI scheme. There are capacities for manufacture of mirrors/ vacuum tubes in india. Though initiatives could be there from Schott/ Saint Gobain for Vacuum tubes/mirrors.
2012	300 MW	40-50%	Mirrors, vacuum tubes, HTF	Boiler Turbine Generator, Balance of Plant, Heat Exchanger. Steel support structures for the solar field.	Solar thermal projects require 20 to 24 months for commissioning from Financial Closure. Projects seriously undertaken early 2010 may be commissioned during the year
2013	500 MW	60-70%	Vacuum tubes, HTF/ Molten Salt	BTG/ BOP / Steel Structures-solar Field and Storage Systems	Mirrors production assumed to take off in India.
2014	800-1000 MW	80%	HTF / Molten salt	BTG/ BOP / Steel Structures-solar Field and Storage Systems	Mirrors / vacuum tubes production assumed to take off in India.

With best regards,  
 Anil Lakhina





30.01.2010

Ms. Gauri Singh, I.A.S.  
 Joint Secretary,  
 Ministry of New and Renewable Energy,  
 Govt. of India  
 Block no.-14, CGO Complex,  
 Lodhi Road, N. Delhi-110003

**Sub: Indigenization/ Cost reduction road map for Solar Thermal Power Projects**

Dear Madam,

This has reference to your e-mail dtd 17.01.2010 on the subject and subsequent discussions undersigned had in your office on 25<sup>th</sup> Jan.2010. It is observed from the contents of the mail that the expectation is such that with every 50 MW plant getting added, the tariff being proposed would go down and the local content would go up.

In this regard, we wish to submit as follows:

1. In CSP technology with towers, presently the solar block, equipment for which are being imported constitutes around 70% of the cost.
2. Power block equipment and balance of plant are being sourced locally
3. Cost reduction will be mainly through:
  - Indigenization/ Developing alternate sources:- around 20-22% reduction
  - Design optimization/ improvements :- around 10 % reduction
4. Indigenization effort will take around 2 to 3 years for development of sources for different items. Such a time span will be necessary to ensure proper verification, quality of locally developed products and trial runs before large scale deployment so that performance of plant is not jeopardized.
5. For inducing local vendors to come forward for indigenization effort they will need to be offered adequate business volumes. Therefore, cost reduction/ indigenization efforts will fructify only if, adequate volumes (approx. 1000 MW by 2014-15) are provided.

Contd...2/-



-2:-

6. Effect of cost reduction efforts would be visible for projects for which orders are placed after development efforts are completed i.e. in Projects to be commissioned after Phase-I of National Solar Mission programme.
  
7. While, there will be cost reduction in respect of Solar Block items, escalation in prices of Power Block and Balance of Plant items is likely to take place with time due to rise in input costs.

Our input in the desired format is enclosed as Annexure-A.

Thanking you,

Yours faithfully,

(R.B. Mishra)  
Vice Chairman

Annexure-A

Year	Capacity of CSP installations adequate to bring more indigenization	Level of Indigenization.	Major imported items	Major items available indigenously	Capital Cost
2010-12	300 MW	30%	Solar Block items <ul style="list-style-type: none"> <li>• Mirrors (5%)</li> <li>• Receiver (20%)</li> <li>• Solar Tracking system (45%)</li> </ul>	<ul style="list-style-type: none"> <li>• Power Block (15%)</li> <li>• Balance of Plant including infrastructure and Misc. (15%)</li> </ul>	Rs 16 Cr./MW
2012-14	500 MW	40%	Solar Block items <ul style="list-style-type: none"> <li>• Receiver</li> <li>• Solar Tracking system (Part)</li> </ul>	<ul style="list-style-type: none"> <li>• Power Block</li> <li>• Balance of Plant</li> <li>• Mirrors</li> <li>• Solar Tracking system (Part)</li> </ul>	Rs 14 Cr./MW
2015-17	500 MW	90%	Solar Tracking system (Part)	<ul style="list-style-type: none"> <li>• Power Block</li> <li>• Balance of Plant</li> <li>• Mirrors</li> <li>• Receiver</li> <li>• Solar Tracking system (Part)</li> </ul>	Rs 12 Cr./MW
2017 onwards	1000 MW	95%	Software for solar tracking	<ul style="list-style-type: none"> <li>• Power Block</li> <li>• Balance of Plant</li> <li>• Mirrors</li> <li>• Receiver</li> <li>• Solar Tracking system except software for solar tracking system</li> </ul>	Rs 10 Cr./MW



Dear Dr Ashvini

Here are the main items that will need to be imported by us if we were to build a plant today

	Approx Costs
Turbine	8%
Mirrors	12%
Receiver Tubes	15%
Heat Transfer Fluid	5%

This is roughly 40%. Over time I am pretty confident that the turbines can be easily be sourced from BHTL and perhaps even the leading global turbine manufacturers will be able to make the products in their existing plants in India. Siemens currently makes many turbines in Baroda and during conversations they have indicated that if the market in India grows this product can be added to the product line in Baroda. Perhaps by year 2013.

Some of the mirror manufacturers I have spoken to are already exploring finishing operations in India. This can also reduce the imported component by 50% for the mirrors. Will be possible as early as 2012 if the market is at least 200MW/year

I am less optimistic about the tubes. This will be a largely market driven exercise. The current plants Schott has set up are able to make 200MW/year or more worth of receiver tubes. Having come from the glass industry I do not believe there are any local companies who can make the product with the specifications required. If the market grown I have reason to believe that Schott or others will come to India.

Our chemical industry is strong. However, I am not aware on any raw material manufacturers who can make the HTF in India. Currently there are only 2 manufacturers globally for this product.

If the first 2 products can be indigenized we are well on our way to getting 80% of the value chain locally.

Any follow-up questions, please let me know?

With regards,

Aseem

**4**

**International Feed in Tariff's & Costs**

# Spanish Feed-In Tariff for CSP: Real Decreto 661

MINISTERIO DE INDUSTRIA,  
TURISMO Y COMERCIO

**10556** REAL DECRETO 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial.

Subgrupo b.1.2. Instalaciones que utilicen únicamente procesos térmicos para la transformación de la energía solar, como energía primaria, en electricidad. En estas instalaciones se podrán utilizar equipos que utilicen un combustible para el mantenimiento de la temperatura del fluido transmisor de calor para compensar la falta de irradiación solar que pueda afectar a la entrega prevista de energía. La generación eléctrica a partir de dicho combustible deberá ser inferior, en cómputo anual, al 12 por ciento de la producción total de electricidad si la instalación vende su energía de acuerdo a la opción a) del artículo 24.1 de este real decreto. Dicho porcentaje podrá llegar a ser el 15 por ciento si la instalación vende su energía de acuerdo a la opción b) del citado artículo 24.1.

- Cost covering with 0,27 €/kWh
- Bankable with 25 year guarantee
- Annual adaptation to inflation
- 12-15% natural gas backup allowed to grant dispatchability and firm capacity
- After implementation of first 500 MW tariff will be revised for subsequent plants to achieve cost reduction

Subgrupo	Potencia	Plazo	Tarifa regulada €/kWh	Prima de referencia €/kWh	Limite Superior €/kWh	Limite Inferior €/kWh
b.1.2		primeros 25 años	26,9375	25,4000	34,3976	25,4038
		a partir de entonces	21,5498	20,3200		

## CSP Feed In Tariff's Worldwide

Feed-In Tariff	Tariff	Tariff Period	Inflation Adjustment	Hybrid
Algeria	100-200%	Life time	yes	?
France	20.95 INR/kWh	20+ years	yes	no
Germany	31.43 INR/kWh	Life time	yes	no
Greece	19.95 INR/kWh	10+10 years	yes	yes
Spain	18.37 INR/kWh	25+ years	yes	max 15%
Italy	23.73 INR/kWh	25 years	yes	yes
India	8.38 INR/kWh	25 years	no	no

78

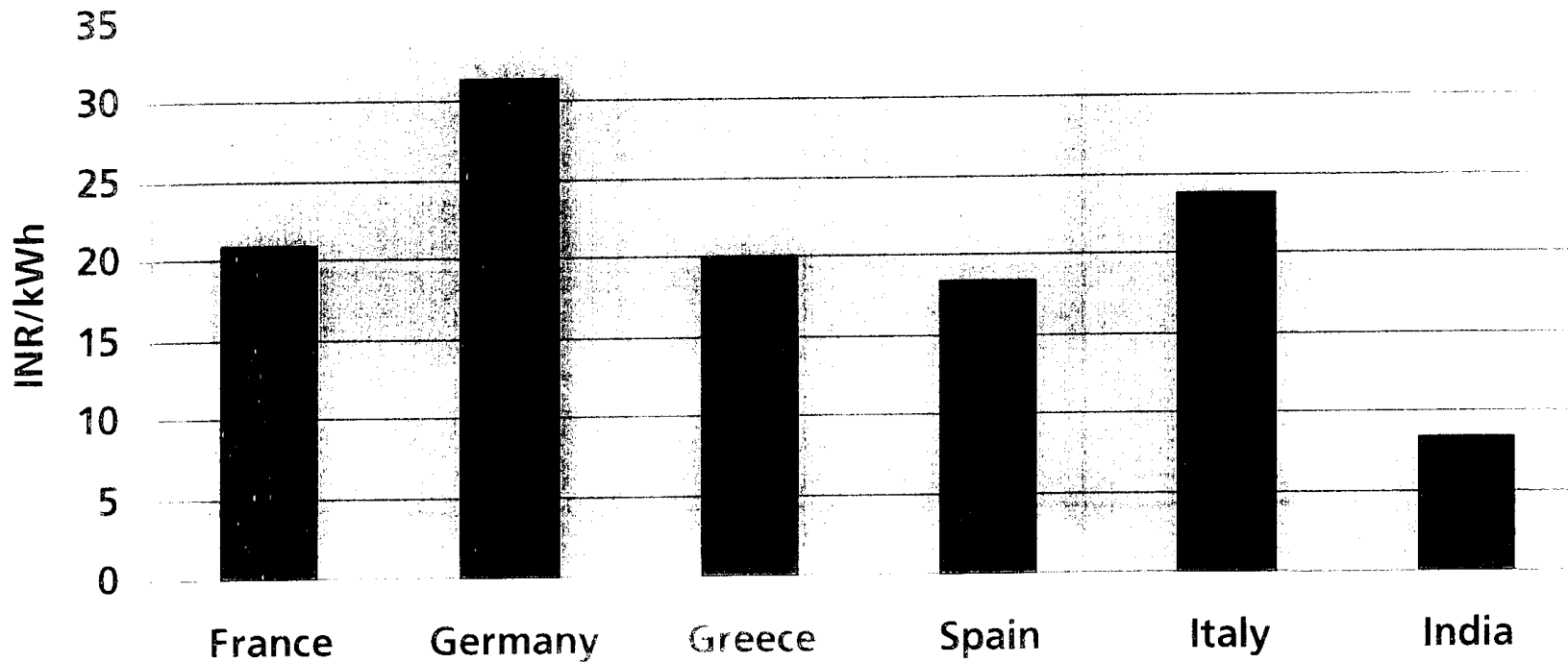
## CSP Vs Domestic Electricity Tariff Worldwide

Feed-In Tariff	Solar Tariff (INR/kWh)	Domestic Electricity Tariff (INR/kWh)	Ratio Solar/Domestic
Algeria	100-200%	-	-
France	20.95	8.16	2.56
Germany	31.43	12.92	2.43
Greece	19.95	4.76	4.19
Spain	18.37	8.16	2.25
Italy	23.73	15.64	1.52
India	8.38	4.5	1.86

64



## CSP Feed In Tariff's Worldwide



08

## Upcoming Feed-In Tariff's

- China: studying CSP tariff of 2-3 RMB/kWh
- Turkey is drafting CSP Feed-In Tariff
- Cyprus is drafting CSP Feed-In Tariff
- Abu Dhabi is discussing CSP Feed-In Tariff

# Abengoa Solar Project Finance

Project Name	Equity Share Abengoa Solar	Investment Volume	Completion	Banks
PS10 11 MW (Seville)	100%	53 Mio €	2006	Caja and Natixis
PS20 20 MW (Seville)	100%	95 Mio €	2006	Caja and Natixis
Solar Power Plant One, S.A. 150 MW Hassi R Mel(Argelia)	100%	316 Mio €	2006	Local banks
Solnova-1 50 MW (Seville)	100%	275 Mio €	2007	Caja Madrid, Natixis, BSCH, Calyon y Societe Generale.
Solnova-3 50 MW (Seville)	100%	268 Mio €	2007	Caja Madrid, Natixis, BSCH, Calyon y Societe Generale
Solnova-4 50 MW (Seville)	100%	265 Mio €	2008	Caja Madrid, Natixis, BSCH, Calyon y Societe Generale
<b>Total 1272 Mn €</b>				

82

**Solar Power for a Sustainable World**

➤ **Solar Block**

- Steam Generator
- Thermal Storage
- HTF Heaters
- Circulation Pumps
- Piping

➤ **Solar Field**

- Receiver Tubes
- Mirrors
- Tracking System
- Reflecting Panels
- Supporting Structure

➤ **Power Block**

- Turbine
- Generator
- Condenser
- Cooling Tower
- Deaerator
- Pumps

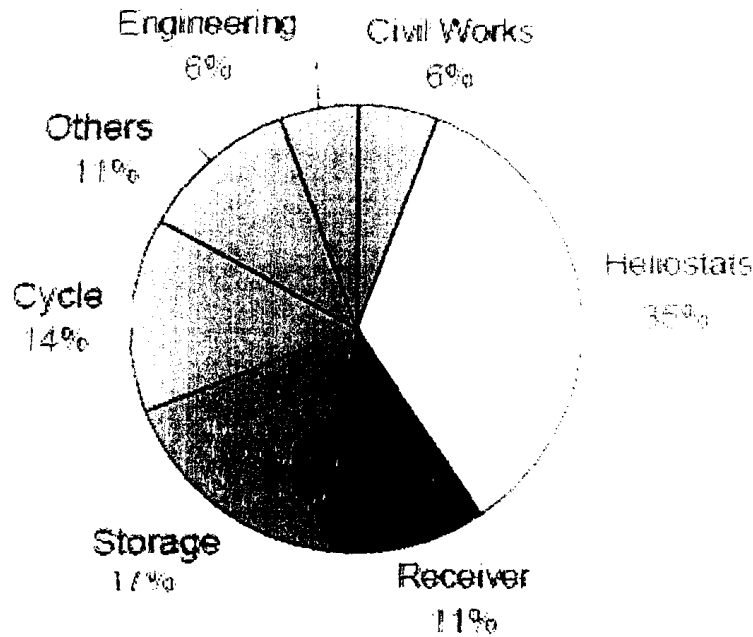
➤ **Civil Works**

- Concrete Tower
- Buildings & Foundations
- Support Structures

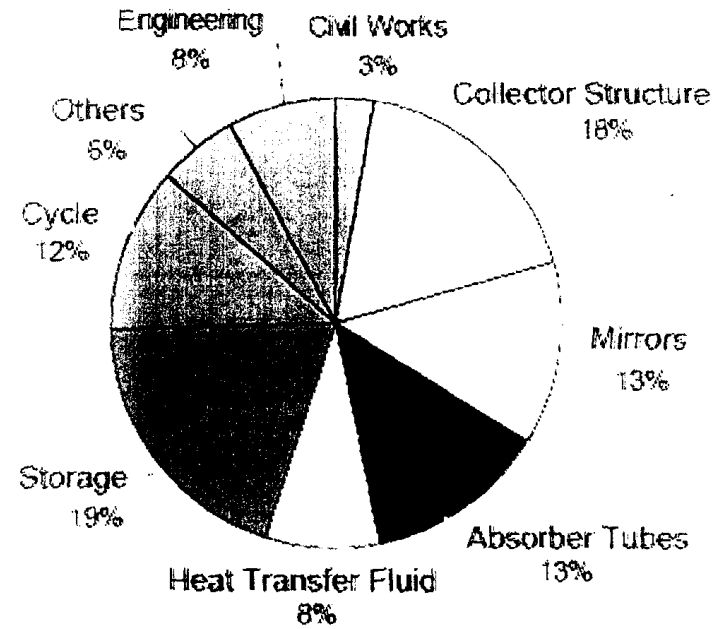
83

## Cost Structure of CSP Plants

### Solar Tower



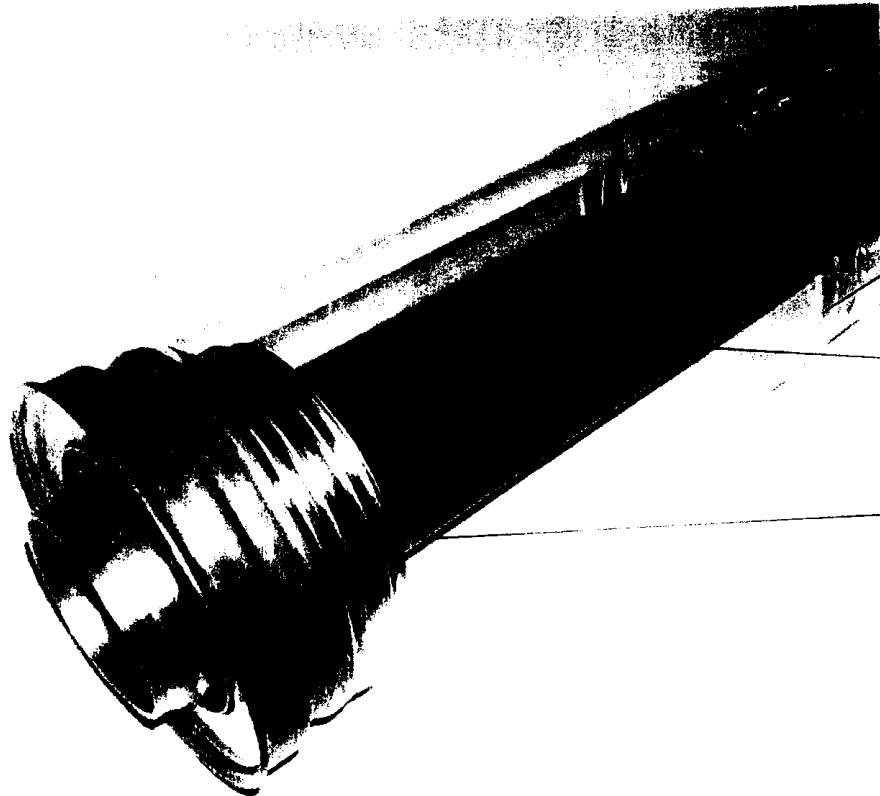
### Parabolic Trough



44

**ABENGOA SOLAR**

**Vacuum Receiver Tube**



Highly transparent anti-reflective borosilicate glass envelope

Specially coated highly absorptive steel tube

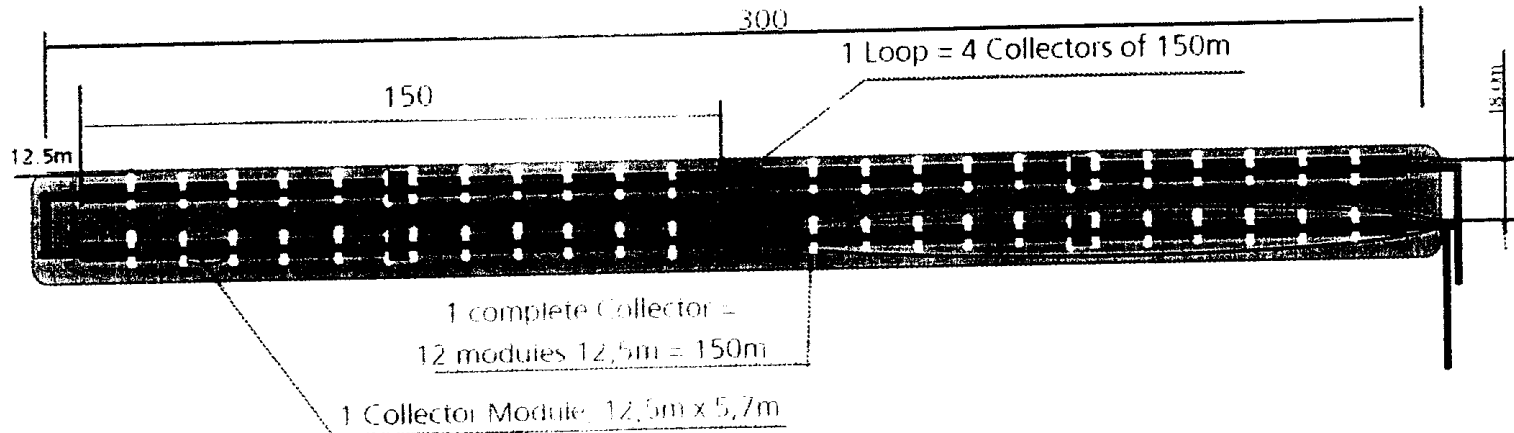
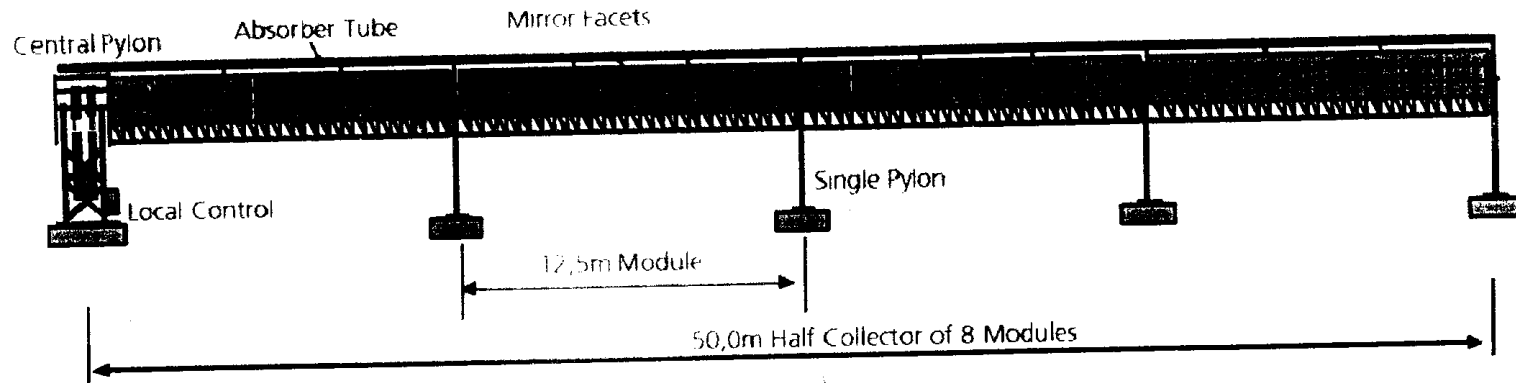
Specially developed very short bellows

85

**Solar Power for a Sustainable World**

# ABENGOA SOLAR

## Parabolic trough loop layout



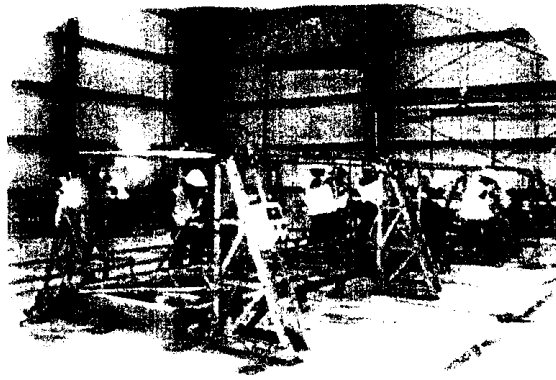
98.

# ABENGOA SOLAR

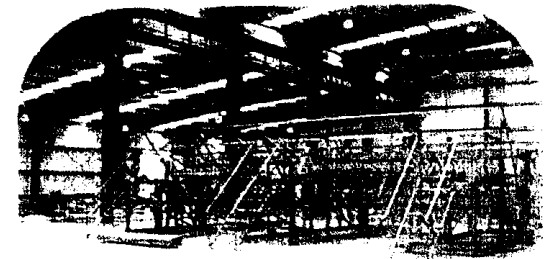
## Parabolic Trough Collector Factory



- Pre-mounting of carrier arms and connections



- Mounting of torque box



- Mounting of carrier arms and connections



**5**

**Comments & Recommendations**

# ABENGOA SOLAR

## Our comments (1)

### ➤ **Capital Cost**

- International tenders in Abu Dhabi, Algeria, Egypt and Morocco 4.5 Million Euro per MW (proven technology without storage).
- Spanish track record 6 Million Euro per MW (proven technology with 8 hours of storage).

### ➤ **Capacity Utilization Factor**

- CUF is lower during stabilization period.
- Increases during first full year of commercial operation
- Upon streamlining of various power plant operations design CUF will be achievable.
- Effect of plant availability and turbine & absorber degradation should be taken in account.
- In absence of authentic measured DNI in the State consideration of higher CUF while determining the tariff may adversely affect the economic viability of the project.

39

### ➤ **O&M Expenses**

- Cleaning and maintenance of mirrors involved considerably cost and increases the O&M costs.
- Daily start and stop operation of the plants results in frequent shutdowns of the boiler, decreases the life of the boiler and increases O&M costs.

### ➤ **Accelerated Depreciation Benefit**

- It encourages Power Producer to take upfront benefits under the tax shield rather than earning their returns through Feed in Tariff over the life of the project.

### ➤ **Sharing of Clean Development Mechanism (CDM)**

- It will prove revenue from CDM is an additional to the normal profit that is being earned rather than to make it viable.
- This will send a wrong signal to the Executive Board of UNFCCC and the probability of the Indian Solar Power Projects getting registered will further reduce

90

# ABENGOA SOLAR

Our comments (5)

## ➤ **Auxiliary Consumption**

- Start up power should be considered as plant auxiliary consumption.

## ➤ **Control Period**

- one year is required for project development and financial closure activities.
- Construction of the plant will take at least 24 months from the date of the financial closure.
- It is not possible to commission the project within given time frame and avail the benefit of the proposed tariff.

## ➤ **Hybrid Technology**

- It will reduce the financial risk of commercial deployment of new technology.
- It allows to convert the solar energy to electricity more efficiently.

16

# ABENGOA SOLAR

## Our recommendations (1)

Parameters	CERC	Abengoa Solar
<b>Capital Cost</b>	INR 13 Crore/MW with no escalation	Reconsider the project cost in the light of international reference.
<b>CUF</b>	23%	18% during stabilization 20% up to one year after stabilization 23% thereafter
<b>Degradation</b>	Not considered	0.5% p.a. up to a maximum of at least 6% for 25 years
<b>O &amp; M Cost</b>	13 Lakh/MW for first year escalating @ 5.72% p.a.	3% capex escalating @ 7% p.a.

92

# ABENGOA SOLAR

## Our Recommendations (1)

Parameters	CERC	Abengoa Solar
<b>CDM Revenue</b>	Shared 50:50 between Distribution Licensee and project developer	100% to project developer
<b>Accelerated Depreciation</b>	Available	No accelerated depreciation.
<b>Hybrid Technology</b>	Kept the provision to look such kind of projects into a specific projects category	Allow 15% gas
<b>Auxiliary Consumption</b>	10%	13%
<b>Feed-in-Tariff</b>	INR 13.45 / kWh	INR 17.5 / kWh 2% annual escalation

93

# ABENGOA SOLAR

## Summary

- India has got huge potential for development of MW class Solar Thermal power projects.
- India may attract ample investment in solar energy due to tremendous solar potential and investor friendly policies.
- CSP technology is highly credible, reliable & simple.
- Presently biggest restraint in the development of CSP Projects is high initial cost due to the fact that all critical components of solar block are imported.
- Installation of capacity at the certain level is required for localization of components.
- CSP is a proven technology but required financial support in form of promotional feed in tariff.
- We are ready to put our practical knowledge at the disposal of Honorable Commission to better inform and establish the technical and commercial viability of all technologies in the field of solar energy.

94

# ABENGOA SOLAR

Solar Power for a Sustainable World

**Solar Power in India**

**February 2010**



56



# ABENGOA SOLAR

## Benchmark of Investment Cost

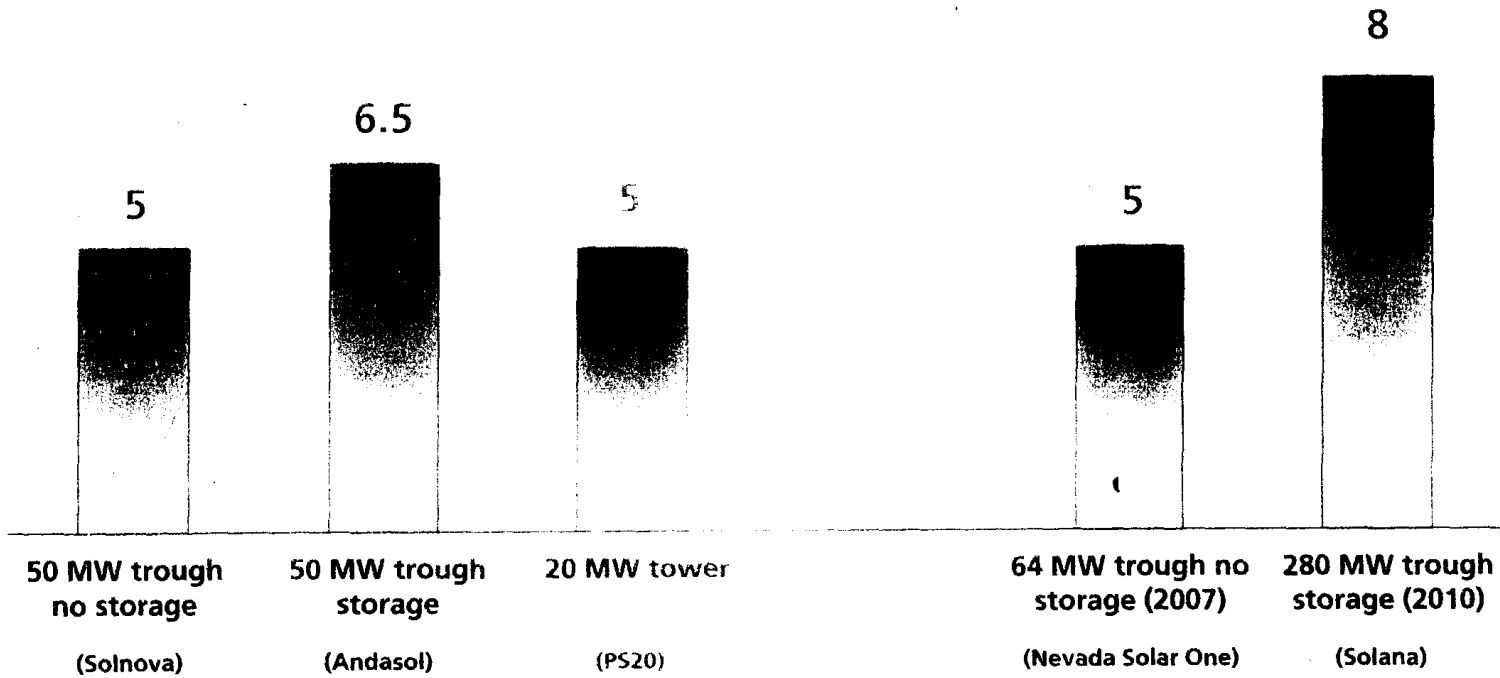
Confidential



€/MW



\$/MW



# ABENGOA SOLAR

## 50 MWs Trough Plant

Confidential

### Investment

Principal systems:	34.9
Auxiliary systems:	13.4
Solar field:	77.6
Electrical systems:	16.4
Civil works:	30.4
Other costs:	26.2
Financial costs:	40.0
<b>Total investment:</b>	<b>238.9 million €</b>

### Production without storage: 90-100 GWh

In Spain, the regulatory regime is set out a **fixed tariff system for CSP**

- ✓ **First 25 years: 27 c€/kWh**
- ✓ 26 years and after: 23 c€/kWh
- ✓ **Tariff will be updated** by CPI -0.25pp until 2012 and by CPI -0.5pp thereafter

# ABENGOA SOLAR

## 50 MWs Trough Plant

Confidential



### Investment

Principal systems:	2,058
Auxiliary systems:	790
Solar field:	3,812
Electrical systems:	967
Civil works:	1,394
Other costs:	1,459
Financial costs:	2,620

### Production without storage: 90-100 GWh

In India, **regulation** is also **needed** to promote solar power

- ✓ **17 INR/kWh**
- ✓ 25 years
- ✓ Tariff updated by CPI or an **escalation of 2%**

**Total investment: 13,100 million INR**

# ABENGOA SOLAR

## 50 MWs Tower Plant

Confidential

### Investment

Principal systems:	39.3
Auxiliary systems:	38.4
Solar field:	94.0
Civil works:	64.3
Other costs:	18.6
Financial costs:	46.1
<b>Total investment:</b>	<b>300.7 million €</b>

### Production with storage: 155-165 GWh

**Tower is also regulated** by the same decree law than trough plants

- ✓ First 25 years: 27 c€/kWh
- ✓ 26 years and after: 23 c€/kWh

# ABENGOA SOLAR

## 50 MWs Tower Plant

Confidential



### Investment

### Production with storage: 155-165 GWh

Principal systems:	2,316
Auxiliary systems:	2,264
Solar field:	4,618
Civil works:	2,948
Other costs:	1,035
Financial costs:	3,098

With a **feasible fixed tariff** system, **tower plants could be constructed in India**

- ✓ 16 INR/kWh with 2% inflation or 19 flat
- ✓ 25 years

**Total EPC costs: 16,201 million INR**

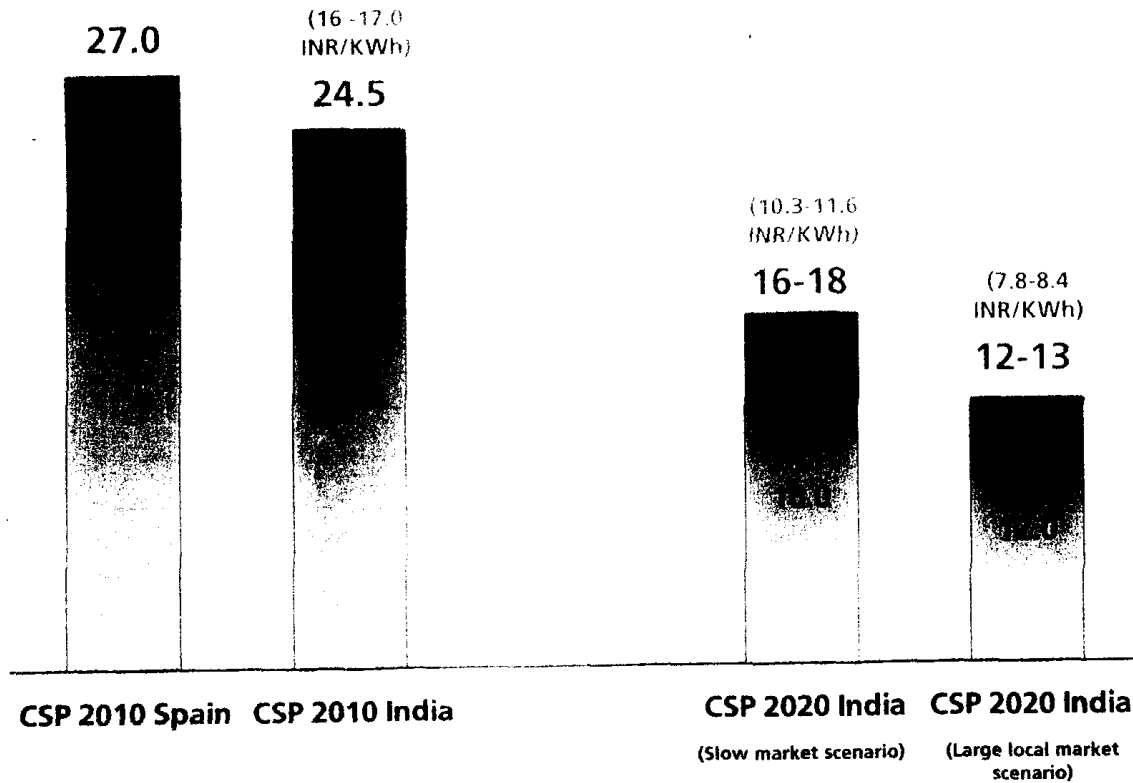
Solar Power for a Sustainable World

# ABENGOA SOLAR

## Technology Cost Today and Tomorrow

Confidential

c€/kWh



Source: Own estimation



Solar Power for a Sustainable World

Information on production capacity of solar PV companies--Presented by Indian Semiconductor Association

S.N.	Companies	Address	Polysilicon (TPA)	Wafering (MW)	Cell	Module	Cell	Module	Cell	Module	Remarks
1	Access Solar	S-5, Phase-II, T.I.E., Balanagar, Hyderabad-500 037			-	18				32	Expanding capacity to 50 MW in FY 11
2	Ajit Solar	E 33-34, RIICO Industrial Area, Bagru, Jaipur - 302			-	20	5%			30	Expanding capacity to 50 MW in FY 11
3	Bharat Heavy Electricals Limited (BHEL)	Mysore Road (periphery of Bangalore)			8	8					
4	Bhaskar Silicon	60A, Diamond Harbpur Road, Thakurpukur, Kolkata	2500	250					30	30	Under constn ; prod in Q1 2012 ; financial closure for wafering to be achieved
5	Euro Multivision Ltd.	Boston House, Suren road, Chakala, Andheri (E) Mumbai			40						Under commissioning - by March 2010
6	Indosolar Ltd	3C/1, Eco Tech-II, Udyog Vihar, Greater Noida			160		95%		200		Expansion during FY 11
7	KL Solar				7	6					
8	Kotak Urja Pvt. Ltd.	# 378, 10th Cross, 4th Phase, Peenya Industrial Estate, B'lore			-	15				10	Expansion during FY 11
9	Lanco Solar		5000	800							600 MW of cells and 950 MW of modules also planned over the 6-yr period
											In Phase I, 1250 MW of polysilicon and 80 MW of wafering to be achieved by Sep 2011
10	Maharishi Solar Technology				3	3					
11	Moser Baer	43 B Okhla Industrial Estate, Phase III, Delhi 110020			80	120	95%	95%	100	100	Expansion during FY 11
12	Photon Energy Systems	775 K, Road No 45, Jubilee Hills, Hyderabad				50		100%			
13	PLG Power	139, A-I, Shah & Nahar Indl Estate, Lower Parel (W), Mumbai			25	50	50%	50%			Expansion during FY 11 - fig NA

102

14	Premier Solar Systems (P) Ltd.					-	30					
15	Rajasthan Electronics & Instruments Ltd.					2	2					
16	Reliance Industries Ltd	Thane Belapur Road, Ghansoli, Navi Mumbai - 400 701					30					
17	Solar Semiconductors	FabCity, Plot No:6, Srinagar village, Maheswaram Mandal, R.R. Dist 501359, A.P.				60	200	32	32			Planned expansion over the future period
18	Surana Ventures					19	38					
19	TATA BP Solar					52	125	80%	80%	128		Expansion during FY 11 - fig NA
20	Titan Energy						100					Cells Supplied by Suniva
21	TopSun Energy						5					
22	UPV Solar - Udhaya Energy Photovoltaics Pvt Ltd					12						
23	USL Photovoltaics PVT Ltd.					6	10					
24	WEBEL SL Energy Systems					40	40	9	9	80	80	Existing capacity achieved few mths back ; expansion during FY 11
25	XL Telecom Ltd.					120	192		80%		40	Expansion during FY 11 ; cell line to start prod in Q2-2010
<b>Total</b>			<b>7,500</b>	<b>1,050</b>	<b>634</b>	<b>1,062</b>				<b>538</b>	<b>322</b>	

**Note**

- \* The data w.r.t. companies highlighted (in blue) could not be confirmed
- 1 The data under exports relates to the proportion of their production (which may not be equivalent to the production capacity) ; exports in MW (absolute data) is given for Solar Semiconductor and Webel SL Energy Systems Ltd
- 2 The data relating to polysilicon and wafering is a long term project plan by the investors - certain caapcities to be created in Phase I been mentioned under "Remarks"

103