BENEFITS FROM PHOTOVOLTAICS IN INDIA

How to profit from photovoltaics



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Photovoltaic is competitive to other energy sources Levelized cost of electricity (LCOE), projections for Germany until 2030





Dependence on site and market conditions LCOE for renewable energy sources 2013





Projections of a strong and long-term market growth PV market development, GW per year

- PV Market is growing rapidly, and globally
- Transitioning from government subsidies to market based asset financing



Excellent business opportunities for various stakeholders



Requirements of stakeholders

- Manufacturers: competitiveness
- Banks: want their money back
- Investors: maximal ROI (yield), minimal risk
- Insurances: minimal risk
- System operators: high performance ratio and low maintenance effort
- Consumers: low costs for electricity at stable supply
- Grid operators: easy integration
- State: positive job effects





Understanding the requirements of stakeholders leads to following requirements

- High quality at competitive costs
- Highly efficient and reliable
- Long-term stable with minimal degradation
- State-of-the-art design
- Optimal system integration and operation
- Adapted grid expansion planning





Support in c-Si technology development and transfer Fraunhofer ISE offerings for manufacturers, I

- Technical and commercial due dilligence studies
 - Roadmapping for future technology development
 - Identification of locally available supply chain and customers
 - CoO analysis and risk assessment for different technology options
 - Efficiency and performance ratio potential
 - Profitability analysis
- Specification and set up of local production facilities
 - Total facility layout
 - Support during procurement of process
 - Sustainability and environmental impact analysis



Support in c-Si technology development and transfer Fraunhofer ISE offerings for manufacturers, II

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- Benchmark analysis
 - Auditing of existing or new production lines
 - Identification of efficiency limitations
 - Recommendations for evolutionary technology upgrades
- R&D collaboration for joint developments
 - Adapted to customer and local market needs
 - Transfer of processes and support in further optimisation
- Education and scientific exchange
 - Theoretical and practical training of employees
 - Supporting local R&D and academic infrastructure













Certification according to Quality Standards TestLab PV Modules



IEC / UL Certification

- Steady State Solar Simulator
- Pulsed Solar Simulator (AAA)
- NOCT Test Stand
- Mechanical Load Test Stand
- Hail Test Stand
- Several Climate Chambers
- Electroluminescence Camera
- Infrared Camera
- Electrical Safety Test Stand
- Module Breakage Test Stand
- Reverse Current Test Stand





Quality Tests Beyond Standard Advanced Tests

- Extended mechanical load test
- Extended hail test
- Salt mist test for maritime climate
- Damp-heat chamber with integrated UV source
- Climate chamber with steady state solar simulator
- Enhanced UV test (90-120 kWh/m²)
- Potential induced degradation test













Bankability and Quality Control Comparative Testing





Example:

Comparison of 14 module types of nine manufacturers

- 400 Thermal Cycles
- Damp Heat 2000 hours







Quality Assurance for Utility Scale PV Plants

Planning and Design	Implementation	Commissioning	Operation
 Solar resource and yield assessment Manufacturer quality benchmarking Module power and energy rating 	 Module performance check Module reliability check Module material check 	 Final acceptance test Initial performance and safety verification PV plant certification 	 Continuous long-term performance reporting Failure analyzes and reporting Optimization and re-powering
		Margarel 2.0.0 0 Margarel 2.0.0 0	2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013



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Investment in PV – cost saving options for electricity supply Hybrid energy system for German industrial companies

Motivation:

Increasing electricity costs while decreasing costs for renewable energy technologies

Increased planning reliability of costs for electricity

In regions with power shortages: improved electricity supply





Modelling the regional market development, as basis for optimal grid expansion planning Example Germany

- LCOE will depend on region
- Investments and LCOE depending on investor type





Energy system optimization

Regional and national analysis of electricity systems

Long-term Scenarios



Location Planning



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Technology Portfolios



Energy Flows





Optimization model for grid expansion planning





SUMMARY

- Photovoltaics is already competitive, a strong and long-term market growth is projected
- Many business opportunities for various stakeholders as manufacturers, banks, investors, insurances, consumers system operators, grid operators
- Fraunhofer ISE offers support for market success within individual objectives

We are happy to support you!



Thank you for your kind attention!



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