



# Off-grid Renewable Energy in India Technology & Service Overview

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## 2014 - 2015

Special Edition for the Intersolar Mumbai, November 2014



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# PREFACE



There is large potential in off-grid energy supply with renewable energies in India, may it be for household level applications, mini grids or larger industrial consumers. However, the markets are fragmented and not easily accessible. Technologies and business models need to be adapted to the regional context and local partners with relevant knowledge play a vital role.

To address this issue and support German technology and service suppliers, which are looking for cooperation and business partners in India and vice versa, this technology and service booklet across different technologies of Indian and German companies active in the off-grid sector has been developed under the framework of the Indo-German Energy Forum (IGEF). This has been achieved in fruitful cooperation with the “renewables – Made in Germany” initiative, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, German Solar Industry Association (BSW-Solar), Indo-German Chamber of Commerce (IGCC), Renewable Energy Cluster Hamburg and Intersolar Mumbai.

The companies listed in this booklet have responded to a request for inclusion sent out by the cooperation partners in October 2014. Whilst they do not represent the entire spectrum of renewable energy technologies and companies active in the off-grid sector in India, the companies on the following pages are fairly representative of the off-grid renewable energy sector in India. For all those who wish to participate in a second edition, we encourage you to contact the IGEF Support Office in Berlin. We hope this booklet will provide you with useful information and valuable contacts to further develop the off-grid renewable energy sector in India. Any feedback you may have for improvement will be very much appreciated.

With best wishes,

Hannah Sternberg

Private Sector Expert

Indo-German Energy Forum Support Office

# COOPERATION PARTNERS







## 1. INDO-GERMAN ENERGY FORUM - IGEF

To enhance and deepen cooperation between India and Germany in the energy sector, the German Chancellor Dr. Angela Merkel and the Indian Prime Minister Dr. Manmohan Singh established the Indo-German Energy Forum (IGEF) at the Hannover Fair in April 2006. The main objectives of the IGEF are to:

- Rehabilitate and modernise thermal power plants
- Encourage the use of clean energy sources
- Disseminate climate-friendly technologies on the energy supply and demand side.

The dialogue focuses on exchanging knowledge, promoting private sector activities and putting in place an enabling environment to further develop the markets for efficient thermal power plant technologies, energy efficiency and renewable energies in India and Germany. The high level steering committee of the IGEF takes place annually and provides a platform for high-level policy makers and representatives from industry, associations, financial institutions and research organizations from both India and Germany. On a working level, thematic sub groups have been created which convene meetings on a regular basis:

- (1) Efficiency Enhancement in Fossil Fuel Based Power Plants
- (2) Renewable Energies
- (3) Demand-Side Energy Efficiency and Low Carbon Growth Strategies.

*For more information please visit [www.energyforum.in](http://www.energyforum.in) or contact the IGEF Support Office in Berlin or New Delhi.*



## 2. RENEWABLE ENERGY COMPONENT OF THE INDO-GERMAN ENERGY PROGRAMME - IGEN-RE

As per Census 2011, almost 400 million Indians do not have access to electricity and about 600 million use polluting, health-hazardous and inefficient biomass stoves for cooking their daily meals; the majority of them reside in rural areas. Even where available, access to electricity is erratic and unreliable hampering the development of rural industries and enterprises. Access to sustainable and clean energy in rural areas can act as means for poverty reduction by providing economic opportunities and improving the quality of life of the rural population.

The Renewable Energy Component of the Indo-German Energy Programme (IGEN-RE) was initiated in 2010 as a collaboration project between Ministry of New and Renewable Energy (MNRE) and GIZ to strive jointly for the promotion of renewable energy in rural areas. The objective of IGEN-RE is to improve the conditions for energy supply based on renewable energy in rural areas. In order to achieve that goal IGEN-RE is engaging in the following types of interventions:

- Implementing pilots together with the private sector to demonstrate replicable business models
- Facilitating the development and implementation of supportive policies and programmes at state and national level
- Capacity development & support for key stakeholders in the rural renewable energy sector
- Facilitating knowledge dissemination through conferences, workshops, and strengthening of practitioner networks



### 3. THE “RENEWABLES - MADE IN GERMANY” INITIATIVE

German companies offer top quality products and services and are market and innovation leaders in the sector of renewable energies due to early and consistent promotion and years of experience. The government has actively been supporting the worldwide dissemination of cutting-edge German renewable energy technology since 2002. The transfer of renewable energy know-how and the promotion of foreign trade are part of the “renewables - Made in Germany” initiative. The initiative is carried out under the auspices of the German Federal Ministry for Economic Affairs and Energy in cooperation with various partner organizations and offers:

#### Networking & business opportunities:

- Business information & contact events
- Trade fair participations
- Flagship projects
- Online business platform: [www.renewablesb2b.com](http://www.renewablesb2b.com)
- Fact-finding missions to Germany for key opinion leaders and companies.

#### Publications

- Technology exhibition, which documents the specific know-how of German companies on 26 charts
- “renewables - Made in Germany” Catalogue and CD-ROM, with an overview of German renewable energy industries and companies
- Specialty Catalogue “Renewable Energy Solutions for Off-grid Applications”
- DVD “renewables - Made in Germany”
- Internet portal [www.renewables-made-in-germany.com](http://www.renewables-made-in-germany.com)

*For further information please contact the German Energy Agency (dena) [renewables@dena.de](mailto:renewables@dena.de) / [www.renewables-made-in-germany.com](http://www.renewables-made-in-germany.com).*



### 4. GERMAN SOLAR INDUSTRY ASSOCIATION - BSW-SOLAR

With more than 800 member companies, Bundesverband Solarwirtschaft e.V. (BSW-Solar) is the interest group of the German solar energy industry. Forming a strong community of companies, BSW-Solar acts as an informant and intermediary between business and the political and public sectors. It represents the common commercial interests of businesses within the solar energy value chain.

BSW-Solar exerts a decisive influence on creating and securing a suitable policy framework for stable growth, and thus on ensuring investment security throughout the solar industry. The objective is to establish solar energy as a permanent pillar of a global energy industry.

BSW-Solar member companies provide excellent engineering solutions in all fields of solar energy generation. BSW-Solar supports their activities by being involved within numerous partnerships with associations and interest groups worldwide. BSW-Solar is involved in market development activities acting as a think tank and multiplier of new business models.

Please refer to [www.solarwirtschaft.de/en/international-activities/export-promotion.html](http://www.solarwirtschaft.de/en/international-activities/export-promotion.html) for more information on the BSW-Solar international activities and an overview of BSW-Solar Member Companies with Export- / International Expertise.



## 5. INDO-GERMAN CHAMBER OF COMMERCE - IGCC (AHK INDIEN)

The German Chambers of Commerce are present in 90 countries with 130 offices worldwide which are of particular interest for German industry and commerce. The Indo-German Chamber of Commerce (IGCC) is one of the biggest bilateral Chambers of Commerce with around 7000 members.

Besides its head office in Mumbai, the Indo-German Chamber of Commerce has branch offices in Delhi, Kolkata, Chennai, Bangalore, Pune and a liaison office in Düsseldorf with over 100 Employees. In addition to this, IGCC has established 9 India-Desks in various bi-national Chambers of Commerce abroad, 18 different Chambers of Commerce & Industry in Germany and has one representative in Brussels. To facilitate better business contacts in India, it has appointed 17 honorary representatives in other towns and cities of the subcontinent.

DEinternational is the Services Department of the Indo-German Chamber of Commerce. It provides Single Window Business Solutions for companies planning to do business with India or Germany. The Market Entry Service is our core service and is supported by Business Advisory, Taxation and Legal services and Recruitment. Other important services include Market Research, Business Partner Search, Event Management, Property Search, PR & Press amongst others. We extend complete support, tailored to the needs of small and medium-sized companies.

*For more information please visit: <http://indien.ahk.de>*



## 6. RENEWABLE ENERGY CLUSTER HAMBURG - A NETWORK FOR POOLING SKILLS

Everywhere in the Hamburg city region, entrepreneurs, scientists and politicians are working to make renewable energy even more of a success. A wide range of industrial and service companies have settled in the Free and Hanseatic City of Hamburg. They range from systems and component manufacturers to project management, installation and maintenance firms and companies offering consultation, certification, financing, insurance and logistics, through to energy providers and traders.

The EEHH “Renewable Energy Hamburg” network (or “cluster”) was set up in order to strengthen and promote cooperation in the sector. It works to pool the wide-ranging skills among companies, research facilities and institutions. It also provides a platform for dialogue among stakeholders, and promotes interfaces to other sectors, such as logistics.

The cluster Renewable Energy Hamburg belongs to the International Cleantech Network (ICN). It hosts international delegations from various countries worldwide to inform them about the German and the Hamburg “Energiewende” (energy transformation).

*For more information please visit: [www.erneuerbare-energien-hamburg.de](http://www.erneuerbare-energien-hamburg.de)*



## 7. INTERSOLAR INDIA – INDIA’S LARGEST EXHIBITION AND CONFERENCE FOR THE SOLAR INDUSTRY

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With events spanning four continents, Intersolar is the world’s leading exhibition series for the solar industry and its partners. It unites people and companies from around the world with the aim of increasing the share of solar power in our energy supply.

Intersolar India is the country’s largest exhibition and conference for the solar industry. It takes place annually at the Bombay Exhibition Centre (BEC) in Mumbai. It focuses on the areas of photovoltaics, PV production technologies, energy storage and solar thermal technologies. Since being founded, Intersolar has become the most important industry platform for manufacturers, suppliers, distributors, service providers and partners in the global solar industry.

Around 200 international exhibitors and more than 8,500 visitors are expected to participate at this year’s Intersolar India. Moreover, 90 speakers and about 500 attendees will discuss current industry topics and shed light on the conditions surrounding technological, market and political developments at the accompanying conference.

Save the dates: Intersolar India 2015 will be taken place on November 18-20, 2015!

*For more information please visit: [www.intersolar.in](http://www.intersolar.in)*

# COMPANY PRESENTATIONS





## BIOGAS

## CORE BUSINESS

Ankur Scientific is a company which has been working in the field of biomass to energy since 1986 and has been developing, manufacturing and marketing 'Ankur' biomass gasifiers to produce a combustible gas for thermal applications and power generation. The company is today seen as one of the global leaders in the field of biomass gasification technology and its equipments are marketed all over the world (more than 30 Countries). In the developing countries, they help to provide energy that is cheap and on-demand, while in the developed countries, they help to make the energy mix more green.

Ankur Scientific offers a wide range of gasifiers ranging in size from as small as 10 kgs to 2,000 kgs. It thus ideal for rural electrification on one side and decentralised and distributed generation of 1 to 2 MWe on the other, which are the needs of any developing country.

There are different types of gasifiers to handle different types of biomass and agriculture residues. More than 50 different species of biomass have been used till date. The systems are so designed that it is very easy to operate and maintain even by the local villagers in rural areas.

## LIGHTHOUSE PROJECT

Ankur Scientific offers wide range of power generation systems ideal for rural electrification like 10 kWe, 20 kWe, 30 kWe, 40 kWe, 70 kWe and so on. The cost of the system would depend on the type of gasifier to be offered which would depend on the type of biomass available or to be used. Moreover the systems can be offered which are very basic or with high degree of automation with automatic start up and remote monitoring features.

Many 10 kWe biomass gasifier based power generation systems with 100% producer gas based engines are being supplied to telecom tower operators to provide power to the towers and thereby replace use of diesel gensets. The systems are with features of auto start/stop and remote monitoring and control systems. Basic systems in India cost anywhere around USD 17,000.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Ankur Scientific is based in the industrial city of Vadodara, in the western state of Gujarat, India where they have their modern and state-of-the-art manufacturing, testing and R&D facilities housed in an eco-friendly environment. It has numerous installations within the wide cross section of Indian industries. The company markets and caters to the requirements of various customers in the eastern, central, western or southern part of the country, apart from exporting to more than 30 Countries across the globe.



## Ankur Scientific Energy Technologies Pvt. Ltd.

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**E-mail** ashok.chaudhuri@ankurscientific.com  
**Web** www.ankurscientific.com  
**Fax** +91-265-2794042

*Biomass to Energy Solutions, Biomass Gasifier Systems, Rural Electrification, Off-Grid Power Plants, Grid Connected Power Plants, Thermal / Process Heat Applications*



10-kWe Gasifier based power generation system for telecom towers.



11-kWe Basic, non containerized power generating system.



**Bebra Biogas Holding AG**  
**Bebra Biogas (India) Pvt. Ltd.**

**Address** Kurze Mühren 1, 20095 Hamburg, Germany  
**Contact** Dr. Dirk Neupert  
**Phone** +49-2319982200  
**E-mail** dirk.neupert@bebra-biogas.com  
**Web** www.bebra-biogas.com  
**Fax** +49-2319982799  
**Address** 5, Surya Mahal Building, First Floor, Burjorji  
 Bharucha Marg, Fort, Mumbai - 400001, India  
**Contact** Mr. Binod Daga  
**Phone** + 91-9910389315  
**E-mail** binod.daga@bebra-biogas.com  
**Fax** +91-22-66459234

*Biogas Plants, Biogas Upgrading Technology, Membrane  
 Upgrading, Organic Waste Treatment, Sewage Sludge  
 Treatment, Water Treatment, Utilization of Biogas*



250kW Bebra compact biogas plant in Germany.



8t/h Food waste biogas plant in South Korea.

**CORE BUSINESS**

Bebra Biogas is an international experienced service provider which offers attractive, innovative, proven and cost effective solutions to convert organic waste materials into energy (electricity or gas-upgrading). We have established operations in India in early 2014 and offer solutions to our Indian customers, which include BOOT, BOT or EPC construction of biogas plants for all types of organic input materials. Our extensive hands-on experience and our team of German and Indian Engineers will serve our Indian customers best in finding the most cost effective and practical solutions. Our innovative technologies to capture and sustain a leadership position in the biogas market include:

- Organic waste treatment: We can provide solutions to treat any type of organic waste through anaerobic digestion, while producing energy. These include food waste, vegetable market waste, slaughter house waste, food processing waste, animal carcass disposal, animal dung and slurry, press mud, poultry litter, etc.
- Waste water treatment: We can also treat any waste water with high BOD content to produce energy
- Utilization of biogas: Generated by sewage treatment plants, distilleries or any other industrial waste water treatment

Please note, that all solutions mentioned above can also be offered on BOOT basis, thereby reducing the CAPEX outflow for our customers.

**LIGHTHOUSE PROJECT**

Bebra biogas plants have been operating successfully for many years in Germany and internationally. Bebra was one of the first companies not focusing mainly on energy crops as input materials but on various kinds of organic waste materials as substrates. Our installation in Korea works completely with food waste, which is supplied by the municipal corporation. The installation is owned and operated by the Bebra subsidiary in Korea.

The Bebra methane plant in Kißlegg, Germany, completed in May 2010 for a large German utility company, was the first membrane-based gas upgrading system in Germany, and with its capacity of 500m<sup>3</sup>/hour it is still the largest membrane upgrading plant in Germany. In December 2010, this gas upgrading plant won an award for the "Product of the Year" by the German Energy Agency (Dena).

**GEOGRAPHICAL FOCUS WITHIN INDIA**

All India.





## Govil Energy Solutions

Address C-2/174, Janakpuri, New Delhi - 110058, India  
 Contact Dr. G.P.Govil  
 Phone + 91-9811345179  
 E-mail govilenergy@gmail.com  
 Web www.govilenergy.com

*100% Biogas Generator, Scrubber (Moisture & H<sub>2</sub>S), Biogas Purification, Biogas Analyzer & Flow Meter, Bio-Slurry Pump, Waste Heat Recovery from Chulhas, Micro Hydel Power*

## CORE BUSINESS

Company business is to supply technology and service for utilization of renewable energy. Company undertakes projects for power generation from wet biomass through biogas, or dry biomass through gasification process. Power generation is from raw biogas (no need to remove carbon dioxide). The system includes the moisture and hydrogen sulfide scrubbing system. Biogas balloons are supplied for biogas storage. Bio-slurry pump can send the slurry directly to field or to storage for transportation to fields. Producer gas can be obtained from dry biomass and power can be generated from gas. Utilization of waste heat recovery from chulhas (wood/biogas stove) for power generation in rural villages. Installation of small hydro-plants where company will provide the consultancy and local people will be trained to fabricate and maintain it.

## LIGHTHOUSE PROJECT

Mr. Mark Clayton Director Qube Renewable Ltd. U.K are making combined heat & power (CHP) using biogas from waste biodegradable material like fruit and vegetable waste, low mong glycol, crimped maize, equine manure with rape straw bedding as well as cow dung

Govil Energy Solutions is associated with them for making CHP. vPower generation is 3.2 KW to 15 KVA. The biogas Generator can be made with higher capacity as well. Power generated is utilized for home and extra is given to grid. It is an off-grid solution. Waste heat from radiator water as well as from exhaust is utilized to heat the biogas digester and other purposes, thus having an overall efficiency of approx. 80%. It has hydrogen sulfide sensor and methane sensor for leakage detection as well as automated shut down. It has two containers out of which one is for biogas production and other is equipped with CHP. Such projects have been installed at number of places. Cost varies as per project.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Company is based in Delhi and installs and supplies throughout India.



Biogas purification system.



15 KVA biogas generator at Behel India.

## CORE BUSINESS

Muni Seva Ashram in collaboration with Excellent Renewable Pvt. Ltd and MSA ERPL Bio-Energy Pvt. Ltd. has been providing biogas plants to industry, institutions and communities for more than a decade, with intention of promoting easy access to renewable energy for sustainable development. We offer EPC, O&M and consulting services for biogas plants of size ranging from 1 to 1,000+ m<sup>3</sup>/day capacity, with purification and bottling systems to allow ease use of biogas in industries and institutions.

Today, biogas plants are effective, economical and environment friendly means of managing waste in urban and rural areas. With advanced technology and our team of experts, we are capable to treat all type of bio-degradable waste and convert the same into renewable energy source. With our team of technical experts, multi-skilled personnel, we are able to offer high quality, customized solutions using appropriate and relevant technologies, while maintaining low cost.

## LIGHTHOUSE PROJECT

The model called Bio-refinery i.e. to make Indian villages self-sufficient from energy point of view. Bio-refinery can also be termed as energy centre. It is an amalgam of suitable rural technology along with social engineering. The first and crucial aspect of Bio-refinery is "Gobar Bank". The concept is to buy cow-dung from the villagers and in return give them the biogas as cooking gas through pipeline along with the organic fertilizer. A passbook is being maintained and the balance is settled every month in cash. As India has got the decentralized way of cow keeping, therefore to ensure the proper supply chain management "Gobar bank" concept was developed at Bhitbudrak village. The model project is already running successfully for the last eight years. Several such models can be replicated.

## GEOGRAPHICAL FOCUS WITHIN INDIA

We are located in Gujarat, 200 km towards North from Mumbai. We, along with our associates have executed projects in Gujarat, Maharashtra, Rajasthan, Punjab and Haryana.

With our team and resources we are capable to execute projects across India and abroad with prime focus on getting projects in Gujarat, Maharashtra, Rajasthan and Punjab.



## Muni Seva Ashram

**Address** Village Goraj, Waghodia,  
Vadodara - 391760, Gujarat, India

**Contact** Mr. Hemant Patel

**Phone** + 91-9879110671

**E-mail** hemant.patel@excellentrenewable.com

**Web** www.greenashram.org

*Biogas Plants, Biogas Enrichment System, Biogas Pressure Regulating Units, ETP Gas Solution, Waste to Energy Plants*



Commercial biogas plant at Abohar, Punjab.



Institutional biogas plant at Muni Seva Ashram, Waghodia.



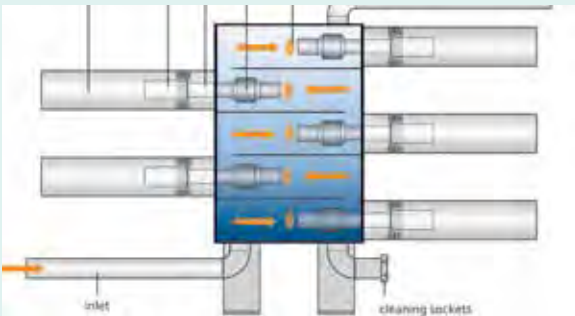
## Ultrawaves GmbH

**Address** Kasernenstraße 12, 21073 Hamburg, Germany  
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**Phone** + 49-40-32507203  
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**Web** www.ultrawaves.de  
**Fax** +49-40-32507204

*High-Power Ultrasound, Disintegration, Biogas, Anaerobic Digestion, Fermentation, Sludge and Wastewater Treatment, Bulking Sludge, Foaming, Nitrogen Degradation, Disinfection, Biomass, Agricultural Biogas Plants, BIOSONATOR, Dewaterability*



Installation of a high-power ultrasound plug-flow system.



High-power ultrasound plug-flow system.

## CORE BUSINESS

Ultrawaves is offering a very effective high power ultrasound technology which increases the efficiency of wastewater treatment plants and farmland biogas plants. Ultrasound stimulates the disintegration of biosolids, resulting in enhanced biogas production, a reduction of sludge, a higher quality of biogas and a reduced viscosity of sonicated material. Ultrawaves' advantages:

- Improved degradation of the organic fraction of the biosolids
- Intensifying of the fermentation process
- Increased biogas production
- Reduced retention time inside the digestion process
- Less residual sludge
- Better dewaterability
- Prevention of bulking and foaming caused by filamentous bacteria
- Optimised nitrogen degradation
- Disinfection of highly turbid media
- Reducing the daily substrate feed on farmland biogas plants
- Enhancing the methane content and therefore the biogas quality
- Lowering the viscosity of the sonicated material and therefore decreasing the electricity demand for mixing and pumping. |

## LIGHTHOUSE PROJECT

"Ultrawaves ultrasound system for improvement of the anaerobic digestion on waste water treatment plants: Bamberg WWTP"

Objectives of the Ultrawaves high-power ultrasound application:

- Intensification of the anaerobic digestion process
- Reduction of the volatile solids concentration
- Increase of the biogas production

Installation of the Ultrawaves high-power ultrasound systems:

- Installation of 2 Ultrawaves ultrasound systems (2 x 5 kW) for a trial period in May 2002
- 30% of the total thickened waste activated sludge flow was treated with ultrasound

Results of Ultrawaves high-power ultrasound trial:

- Construction of a new digester (est. investment costs: 2.5 million Euros) was avoided
- Intensification of the sludge digestion: degradation of volatile solids increased from 34% to 58%
- Quality of the digested sludge: reduction of the volatile solids (as per cent of DS) from 60% to 54%
- Biogas production: increase of 29%
- Permanent Installation: Two Ultrawaves high-power ultrasound systems are permanently installed since August 2004

## GEOGRAPHICAL FOCUS WITHIN INDIA

All India.



## SOLAR PV

## CORE BUSINESS

EMPO-NI was founded in 2006 and belongs to Germany's most innovative companies. We are an international company that has specialized in the development and production of off-grid applications. Our team of experienced engineers is located in Düsseldorf, Germany and develops based on state-of-the-art microprocessor and power electronics technology standard and customized solutions. Innovations like battery charge controllers for thin film technology based PV panels and robust small solar module integrated battery charge controller are part of EMPO-NI's product portfolio as well as Maximum Power Point Tracking (MPPT) charging technology for Pb based or various Li-Ion batteries. We manufacture complete autonomous power supplies and robust outdoor Solar Direct Drives (SDD) for pumping and ventilation applications with GSM and enhanced system control functions. We manufacture and distribute our standard and innovative solutions across Europe and worldwide through our network of partners and distributors

## LIGHTHOUSE PROJECT

The Solar Direct Drive (SDD) is used in 2 test installations by our Indian partner in the northern region (Punjab) of India. The drives operate a 4 kW existing 3~ submersible pump in a well to provide water for agricultural purposes. The system has been powered by a diesel generator before. Since the SDD has IP54 protection degree, the unit is mounted without additional protective enclosure and the natural convection sufficiently cools the device even at 50°C of ambient temperature, which in this region hasn't yet been reached. A locally manufactured PV array consisting of 20 pcs of 250W and a zinc coated metal sub construction with PV array anti-theft lock provide a stable ground. The total cost, excluding the pumps, is about 4,000 €. Considering the actual diesel liter price of about 0,76 €/l and the consumption of about 4 l/hour of the previously used diesel generator, the investment will pay off within approximately 1,315 hours of operation which makes this system ideal for a cash flow based financing even without subsidies of currently 30% on the investment.

## GEOGRAPHICAL FOCUS WITHIN INDIA

The installation focus is clearly in the agricultural area of India, e.g. mainly the northern / north-western region of India since the new government of India will grant the subsidies mainly for this market segment. The north-west Punjab and Haryana region seem to be the epicenter for irrigation systems and agricultural water supply.



### EMPO-NI off-grid solutions

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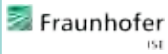
*Solar Direct Drive, Integrated Battery Charger, MPPT Solar Battery Charger, Solar Power Units, Product Development, Production, Technical Consulting*



Solar Direct Drive



MPPT SOLAR battery charger SOL-1



## Fraunhofer Institute for Solar Energy Systems ISE

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 Web www.ise.fraunhofer.de  
 Fax +49-761-45889281

*Research and Development, Testing, Off-Grid PV Systems, Pico PV Systems, Solar Home Systems, PV Hybrid Systems, Batteries*



CPV stand-alone system in the Wadi El Natroon, 100 km northwest of Cairo, Egypt.



Training of Chinese staff for monitoring of PV hybrid systems by Fraunhofer ISE.

### CORE BUSINESS

Founded in 1981 the Fraunhofer Institute for Solar Energy Systems ISE is a member of the Fraunhofer Gesellschaft and conducts research on the technology needed to supply energy efficiently and on an environmentally sound basis in industrialized, threshold and developing countries. To this purpose, the Institute develops systems, components, materials and processes in the areas of thermal use of solar energy, photovoltaics, solar architecture, electrical power supplies, chemical energy conversion and rational use of energy. With a staff of above 1,300, Fraunhofer ISE is the largest solar energy research institute in Europe.

Fraunhofer ISE builds on more than 30 years of practical field experience and provides comprehensive knowledge in all areas of rural electrification, building efficiency and water treatment like product and system development, optimization and testing, planning, system maintenance, monitoring and evaluating of projects. For industrial, institutional and consultant customers we offer:

- Development, optimization and testing of components and systems for Pico-PV, solar home systems and PV hybrid systems
- System design, optimisation and evaluation of PV hybrid systems with and without battery
- Development of energy management systems, battery management systems, operating strategies
- System maintenance, monitoring and quality assurance
- Development of quality test methods
- Training courses

### LIGHTHOUSE PROJECT

“Energy Management for an Off-Grid CPV system in Egypt”

In a research project in Egypt, a concentrating photovoltaic (CPV) 30 kWp stand-alone system is developed to provide electric power for water pumping, desalination and irrigation applications. The project was funded by the European Commission. The core of the development work is an intelligent energy management system, which ensures maximum direct usage of the available solar energy. This reduces intermediate storage in batteries to a minimum and thus significantly lowers the costs for the storage units

We initially developed a priority controlled algorithm, which switches loads on or off according to the currently available solar energy or adjusts them according to the solar energy supply. In this way, the available energy is supplied directly to the loads and the storage unit is bypassed. At present, a new algorithm to calculate weather forecasts is being tested in the laboratory. This serves to define a load schedule for the following day, and specially developed algorithms then optimize the priority ranking and energy utilization. In this way, the system efficiency can be increased further. Actually, we have projects to bring optimized operation with such algorithms to PV diesel and PV battery systems in Micro Grids.

### GEOGRAPHICAL FOCUS WITHIN INDIA

All India.

## CORE BUSINESS

We are engaged in our in-house manufacturing of solar panels, solar lanterns, NABARD systems and solar home light systems in our manufacturing facility at Haridwar (Uttarakhand). We are having a capacity of 25 MW/year of PV modules having a wide range from 1 Wp to 300 Wp. We are having 2 manufacturing units at present and 2 more facilities are going to be operational in April 2015.

## LIGHTHOUSE PROJECT

“100 KV Project at Gautam Solar plant in Haridwar”

- Cost : INR 1.75 Crore (approx. 227,000 Euro)
- Financed by the Ministry of New & Renewable Energy (MNRE)

## GEOGRAPHICAL FOCUS WITHIN INDIA

We are having our network across the country, but mainly in Uttar Pradesh, Bihar, Jharkhand, Haryana, Rajasthan, Maharashtra and Kashmir as power demand in these states is more than others because of lesser power generation then the actual demand.



**Gautam Solar Pvt. Ltd.**

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*Solar Panels, Solar Lanterns, Solar Home Light Systems, Solar Street Lights, Solar Power Plants & Solar Water Pumps*



100 KV Project at Gautam Solar plant in Haridwar.



Gautam Solar lighting products



## Intech GmbH & Co.KG

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*Photovoltaic, Turnkey Solutions, Rural Electrification*



Intech solar tracker.



Marketpally Inverter.

## CORE BUSINESS

Intech GmbH & Co. KG develops renewable energy projects worldwide. We offer turnkey solutions for solar, wind, biomass and water systems. Our scope of service covers the complete project management and ranges from the feasibility study to the commissioning of the plant.

Within the field of photovoltaic, many applications are possible: feed-in energy into the grid, built a local electrical supply for unconnected houses/villages, reduce energy consumption in diesel powered systems, or maintain continuous power supply during grid failures. Solar panels can be installed on roof, ground-mounted or on tracking systems. Intech develops its own tracking system to provide up to 20% more energy. Intech's tracker is easy to install and robust. It can be installed in hard climate regions.

## LIGHTHOUSE PROJECT

Intech equipped the education centre of the Mother Teresa Rural Development Society (MTRDS) in Narketpally (State of Andhra Pradesh, South India) with a photovoltaic system and a water treatment plant. This project is part of the worldwide "dena Solar Roofs Programme" coordinated by Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency.

- Uninterruptible power supply for the education centre through the installation of an 8 kWp PV island system.
- Safe drinking water through the installation of a water treatment plant to eliminate the excessive salinity and fluoride content in the water.
- Cost: 190,000 Euro (Marketing + Technical)
- Finance: Co-financed by the German Federal Ministry of Economics and Technology (BMWi) within the initiative "renewables – Made in Germany" – 45%

## GEOGRAPHICAL FOCUS WITHIN INDIA

Intech is looking for partners in the regions were many grid failures occur or where soil is adapted for large scale photovoltaic fields.

Intech will focus on following regions: Andrah Pradesh, Karnataka, Tamil Nadu und Kerala.



## CORE BUSINESS

The juwi group with a goal for 100% renewable energies is one of the world's leading specialists for renewable energy with a strong regional presence. juwi offers project development as well as services for the energy turnaround. juwi was founded in 1996. Since then, juwi has realized around 800 wind turbines which make up for 1,700 megawatts and has designed and constructed 1,500 solar power projects with a total capacity of around 1,400 megawatts.

From the headquarters and the subsidiaries, juwi develops, engineers and constructs off-grid projects - worldwide. These systems are energy supply solutions that are not connected to the public grid. They provide clean and renewable electricity for communities, private or public consumers in remote areas.

juwi India Renewable Energies is a wholly owned subsidiary of the juwi group. In a little over three years, juwi India has already made a name for itself in the Indian solar industry by connecting to the grid over 83 MWp of free-field solar power plants in states like Rajasthan, Gujarat, U.P, M.P and T.N and currently 22 MWp are under execution. juwi India brings you a full-service, specialist PV solution – be it for off-grid, free-field, or roof-top projects.

## LIGHTHOUSE PROJECT

On the islands of Ungoofaaru and Kudahuvadho, Maldives, juwi installed more than 1,280 solar panels with a joint capacity of 327 kWp on a total of eight rooftops. The project was realised for the Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ). FENAKA, the local utility is operating both plants.

With the Solar Fuel Saver (SFS), the PV plants were integrated into the existing diesel generator systems which provide the islands' power supply. The solar energy is fed directly into these grids, reducing the electricity demand at the diesel generator. The SFS controls the feed-in power of the solar plant considering the diesel generators' operation point.

Thanks to the hybrid solution, approximately 115,000 liters of diesel can be saved every year. Via an online portal, the operation parameters of the PV-plants and the diesel generators can be monitored.

Long transport routes, heat, monsoon-like rainfalls and the fasting month of Ramadan: The projects on the Maldives brought some challenges to the juwi Off-Grid specialists. But thanks to their years of experience in building photovoltaic power plants, the juwi engineers flexibly adjusted the construction works to the local circumstances. Thus, the two island projects could be put into operation in less than three months.

## GEOGRAPHICAL FOCUS WITHIN INDIA

juwi India is headquartered in Bangalore and has a regional office in Delhi. It has executed freefield grid-connected projects in the states of Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh and Tamil Nadu. The projects in these states have been aided by high solar insolation and Government policies. Karnataka, Telangana and Andhra Pradesh will be the next focus states for juwi owing to favourable Government policies. Roof-top solar projects will be coming up in many states across India based on net-metering policy in the near future. Moreover, juwi India will look into the upcoming segment of solar/diesel hybrid systems in the Indian subcontinent.



**juwi international GmbH**

**juwi India Renewable Energies Pvt. Ltd.**

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*Solar/Diesel Hybrid Systems, Battery-Based Hybrid Systems, Solar Pumping Systems, Grid-Connected Solar, Solar EPC*



Solar installation on residential buildings on Kudahuvadho Island, Maldives.



Solar installation on sewerage building on Ungoofaaru Island, Maldives.



## Multicon Solar Group

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*20-Foot Solarcontainer, Multicontainer, Solar Power Trailer, Project Planning, Installation, Photovoltaics Systems*



Solar power plant with multicontainers.



Multicon Solar solar trailer.

## CORE BUSINESS

The Multicon Solar Group is providing services for the PV-industry and is developing new products for the electrification of remote areas. Our main focus is the development and distribution of innovative OFF-GRID and MINI-GRID solutions. Especially our mobile solar power plants like the Multicontainer - a container with retractable solar panels - or our mobile solar water pump enables an independent and efficient power supply for every purpose

## LIGHTHOUSE PROJECT

Our multicontainer was sold to the German military. In the future, the multicontainer should replace the diesel generators in the military camps. For this project, the Multicon Solar Group is developing together with the German company ZBT - Duisburg (university spin-off) a multicontainer which produces hydrogen.

## GEOGRAPHICAL FOCUS WITHIN INDIA

All areas receiving the most sunshine in India, especially in the western states, southern states and some central states. Because the sunshine can average above 2.400 hours per year in these locations, they would be good areas to target. The utmost concern of the Multicon Solar Group is to supply the off-grid systems in both government and private sectors. We want to furnish big institutions like hospitals, mine working, military and refugee camps with our mobile off-grid systems, providing a temporary or long-term electricity generation site to serving as an emergency power generator as well as an adequate substitute for power grids and diesel generators. We are looking for cooperation partners and joint ventures.



**ONergy**

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*Solar Lanterns, Solar Small Lights, Solar Home Electrification System, LED Lighting, DC Pedestal Fans, DC Ceiling Fans, DC Box Fan, Solar Irrigation Pumpset, Solar Cold Storage, Solar Refrigeration, Solar Plants, Solar Sewing Machine, Solar Water Heaters, Solar Street Lights, Solar Garden Lights, Solar Buoys*



Source, pump set and control unit.



ONergy's home electrification of BoP.

## CORE BUSINESS

**Core Technology:** ONergy deals with technologies related to solar power generation. We also deal in energy efficient luminaries, solar pump sets, solar refrigeration, solar water heating systems & solar electronics.

**Core Business:** ONergy's core business is rural sales and distribution, which we achieve through our network of rural partners. ONergy is also involved in the business of rural development through solar interventions, like solar micro grids, solar irrigation projects, cold storage and street lights. ONergy currently has 10 offices in the states of West Bengal, Odisha and Jharkhand. We have 80 employees. Our turnover for the FY 2013-14 was around INR 5 Crores (approx. 650,000 Euro). We are expecting to breakeven on operational cost in the current financial year.

## LIGHTHOUSE PROJECT

ONergy provides customized solar irrigation pumping solutions, based on local groundwater table, solar insolation and irrigation water discharge conditions in order to attend the farmers' needs. Furthermore, there are a large number of agriculture pump sets that currently use diesel power where there is no grid connection available. Solar power is already cost competitive with diesel power and solar PV installations are well suited to replace diesel consumption. Replacing diesel pumps, solar powered irrigation pumps are cheaper, longer lasting and more reliable than diesel powered irrigation pumps. These solutions will meet irrigation water needs of rural population in power-deficit regions in India by sourcing proven, reliable and high quality solar PV technologies.

Technical Details of Installed Pump & PV Modules	Size	Unit	Total Size
Solar Panel	150 Watt	16	2.4 KW
Pump	2 HP	1	2 HP
Inverter	3 KW	1	3 KW

Technical specification of 2 HP solar surface pump (AC pump) costing approx. 3 Lac

## GEOGRAPHICAL FOCUS WITHIN INDIA

We are primarily working in the states of West Bengal, Odisha and Jharkhand. We are also conducting projects in other states of India.



## Phocos India Solar Pvt. Ltd.

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*Charge controllers, Pico Systems, DC-Lamps, DC-Fridges and Freezers, Inverters and other DC-appliances for the off-grid market.*



The solar juice stall has 1,000 watts of solar modules, a Phocos CX40 charge controller, a FR240 refrigerator/freezer, a SL-LED lamp (3 W), and a mixer.



Phocos held a branch opening ceremony in Pondicherry (South India) in January 2014.

## CORE BUSINESS

Solutions for the autonomous power supply: Phocos AG is among the world's leading manufacturers of solar charge controllers, Pico systems, and components for autonomous power supply. Inverters and energy-saving appliances, such as lamps and refrigeration/freezing appliances, supplement the product range. The products developed and produced by Phocos enable the eco-friendly and efficient use of solar energy.

Core competence: off-grid PV installations: A PV system consists of four parts: solar modules, a solar-powered charge controller, a battery, and electric power devices. Solar-powered charge controllers from Phocos are an essential part of such systems. They safeguard the battery against overcharging as well as against a discharge in excess of a given limit value. In addition, Phocos charge controllers increase overall system efficiency.

Markets: Phocos' core markets are: rural electrification (especially in developing and emerging economies), mobile and stationary industrial applications, off-grid street lighting, and leisure applications such as RVs and boats. Other areas of application include telecommunications and heavy-industry operations. German company at home in the world: Phocos has manufacturing capabilities in all its major markets: China, India, and Bolivia. Corporate headquarters and engineering are based in Ulm, Germany. Twelve holding companies and service offices worldwide give Phocos a global presence.

## LIGHTHOUSE PROJECT

"A juicy business"

In Pondicherry, South India, stall operator, Mr. Ramadass, has created a new business: He sells juice drinks chilled from a solar powered stall. Every day the stall attracts hundreds of customers at the sea front. All the power he needs for this venture comes from the solar panels fitted to the top of his cart. The panels also serve as a roof for the cart and can generate around 1,000 watts of solar power. The implemented charge controller CX40 (40 A) from Phocos regulates the energy flow and prolongs the battery lifetime. The Phocos SL-LED-lamp (3 W) and the Phocos FR240 cooling device work on 12 and 24 volts DC basis, whereas the Phocos SI350 inverter transforms the DC-energy to 230 V, allowing the operation of the AC-mixer.

The new FR240 refrigerator/freezer offers 240 liters of capacity. The FR240 is also very flexible, as it can be used both, as fridge or as freezer in the temperature range from minus 18 degrees Celsius to plus 6 degrees Celsius. "The reliability of the solar system means I am able to prolong my opening hours from 6 until 10 p.m.," Mr. Ramadass tells us proudly.

## GEOGRAPHICAL FOCUS WITHIN INDIA

In January 2014 Phocos moved from the previous premise in Pondicherry, South India, to a new and bigger building within the same city. The Indian branch includes an own modern production, an administration, a sales and a service department. The company offers products and services in the whole of India. This includes products in high as well as low power ranges and even solutions, which are customized especially for the Indian market.

## CORE BUSINESS

Photon Energy Systems Limited is one the oldest and leading solar energy companies in India since 1995. Photon is one of the leading manufacturers and installers of solar pv modules, solar rooftop power plants both off-grid and on grid, solar megawatt plants and solar water heating systems. Photon solar modules are all IEC 61215, 61730 and 61701 certified from TUV and UL up to 305Wp and all our products are approved by MNRE, India. Till date Photon has supplied, installed and commissioned over 3 MW solar rooftop plants and 65 MW utility scale (megawatt) solar power plants in India.

## LIGHTHOUSE PROJECT

“Complete turnkey project for supply, installation and commissioning of 500 KW on grid solar system at Kalinga Institute of Social Sciences Bhubaneswar, Odisha”

Kalinga Institute of Social Sciences (KISS) is the largest residential institute for the tribals in the world, providing accommodation, food, health care, education from KG to PG, vocational training and all other basic amenities of life absolutely free.

This project, financed by Solar Energy Corporation of India, completely powers the electrical consumption of the campus of Kalinga Institute of Social Sciences in Bhubaneswar, Orissa with solar power. All the buildings of the Institute are now installed with solar rooftops to supply power during the day-time to all the class-rooms. The total Project Cost for the 500 KW solar plant was INR 4.05 Crores (approx. 525,000 Euro).

## GEOGRAPHICAL FOCUS WITHIN INDIA

All of India with primary focus on major cities of South India and Orissa.



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*Solar Power Plants, Off-Grid & Grid Connected (Rooftop & Megawatt), Solar Water Heating Systems*



KISS 500 KW solar plant, Odisha.



E.I Dupont 25 KW solar plant.

## CORE BUSINESS

PSE provides consulting and project management for the assessment, implementation and monitoring of solar installations worldwide. PSE has worked extensively in the evaluation of rural electrification programs such as a technical and economic assessment of rural solar hybrid systems in Malaysia. PSE also has expertise in solar system monitoring, for example an assessment of over 5,000 solar home systems in Bangladesh and a country-wide PV monitoring and benchmarking project in India. For over seven years, PSE was the representative office for rural electrification of the German Solar Industry Association (BSW).

Our clients include government agencies, development banks and development aid organizations with programs to provide electrification to rural areas. We support our customers with the knowledge and expertise to make effective decisions regarding rural electrification programs and the transition of a conventional energy system by embedding renewable energies.

## LIGHTHOUSE PROJECT

“Technical-economical evaluation and recommendations on solar hybrid systems in Malaysia”

The Government of Malaysia has funded the implementation of 250 solar hybrid systems in rural areas. The investment amounted to approx. 250 million Euro.

The objectives of the study were to:

- Assess the effectiveness of existing solar hybrid programs
- Review the sustainability of technology, economics and management of solar hybrid projects
- Deliver a financial justification and a proposal of a new model for implementation of future solar hybrid projects in Malaysia
- Develop a new streamlined operation model for future solar hybrid systems taking into account cost control and performance-based refinancing.

The study found that the technical and operational components of the program were capable and appropriate, with greater emphasis needed on long-term maintenance planning. When compared to diesel generated electricity, solar hybrid systems would have an economic payback within three years. Greater program costs savings could also be realized with the use of an open tendering process.

PSE recommended a streamlined operational model for the deployment of solar hybrid systems in Malaysia and coordinated these efforts with the office of the Prime Minister of Malaysia.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Since 2011, PSE has been working on an on-going country-wide monitoring and benchmarking program in India. The objective of the “Solar Mapping and Monitoring in India” project is to maximize electricity production from existing solar PV power plants in India. In cooperation with the Ministry of New and Renewable Energy (MNRE), PSE is monitoring 119 PV Power plants in 12 Indian states with a total installed capacity of 518 MWp (roughly one quarter of all PV plants).



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*Market Assessment, Feasibility Studies, Program Evaluation, PV Plant Monitoring, Benchmarking*



Assessment of solar hybrid systems and evaluation of the solar hybrid program of the government of Malaysia.



Assessment of solar hybrid systems and evaluation of the solar hybrid program of the government of Malaysia.

**solarnova**

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*Solar PV, Architectural Photovoltaic, Building Integration, Standard Modules, Module-Manufacturer, Specialist in PV*



Facade integration of solar modules in the facade of the "Active House" in Frankfurt.



Solar PV on the roof of the "Active House" in Frankfurt.

## CORE BUSINESS

solarnova is a German technology company with more than 30 years of experience on the photovoltaic sector and in the production of solar modules. Our modules are manufactured exclusively in Germany.

Decades of experience in solar technology, state-of-the-art production methods and our high awareness of quality make solarnova a reliable partner.

At our site in Wedel, Schleswig-Holstein (North Germany), we produce top quality photovoltaic elements as customized solutions for building integration, standardized double glass modules and the solarnova high performance module SOL GT.

## LIGHTHOUSE PROJECT

"Active house in Frankfurt generates surplus power with the help of solarnova facade modules"

Solarnova modules specifically made for facade integration have been supplied to the "active house", an energy efficient lighthouse project of the AGB Holding and HHS AG architects in Frankfurt. The building is highly energy efficient and overall generates more energy than is consumed by the inhabitants. The facades and roof contain integrated solar modules that have been specifically manufactured in black to match the architecture. They supply 114 kWp and are connected to a battery for on-site storage and consumption of the generated power.

## GEOGRAPHICAL FOCUS WITHIN INDIA

All India.

## CORE BUSINESS

Ranging from distributing complete off-grid kits over professional consultancy to planning and building turnkey off-grid systems with Solarscout Eifel you benefit from German engineering excellence. We offer solutions for every project size and application.

## LIGHTHOUSE PROJECT

“Private Home PV off-grid system - energy for day and night”

The Sun is shining and 36 cells PV modules are gleaming in the sun of Egypt for a private home. Energy that not needed during the day is available at night. During night time, high-end solar batteries supply 12/48 V DC and 220 V AC energy for light, television, air conditioner and kitchenware.

The Private Home PV off-grid system produces 24 kWp and was privately financed.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Solarscout Eifel offers a complete range of services and flexibility to meet your needs, all India.



## Solarscout Eifel

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*Photovoltaic, Off-Grid Installations, High-End Solar Batteries, Inverters, Solar Modules, Charge Regulators, Batteries, Mounting Systems*



Private home pv off-grid system in Egypt, size: 24 kWp



Photovoltaic off-grid installation with high-end solar modules/inverters/batteries, size: 98 kWp.





**SolarSpring GmbH**

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*Solar Desalination, Solar Water Purification*



Drilling of bank filtration well in Kalyani in West Bengal, India, SWINGS-project.



SolarUF0.1 solar – capacity 100 liter per hour.

## CORE BUSINESS

Fresh water of sufficient quality for human consumption is becoming a scarce resource and its availability is a concerning issue all over the world. Various water treatment technologies are available on the global market to meet increasing energy & water needs in developing countries. SolarSpring GmbH (SSP) is working on the development, design, production and distribution of small-scale solar powered water treatment systems for remote areas. Important for these markets is that SSP also holds knowledge in the evaluation and validation of socio-economic aspects. SSP technological solutions desalinate and treat seawater and non-potable water using solar energy or waste heat. These clean energy sources are used to power technologies such as:

- membrane distillation (desalination and industrial applications for e.g. wastewater and water recycling)
- ultrafiltration (purification for potable water production)
- UV disinfection (purification for potable water production)
- anodic oxidation (purification for potable water production)
- reverse osmosis (desalination)

## LIGHTHOUSE PROJECT

The first Indian installation SolarSpring has realized, a SolarUF-plant, was installed in April 2012 for the Hope Project in Delhi. This project includes a school and a community health centre amongst others for which the highest standards of drinking water are required. It was installed on the roof of the building to supply the whole project with safe and pure drinking water.

In addition, SolarSpring is partner in two promising European projects (Water4India and Swings, funded by EC and DST/India), where European and Indian experts are studying the different centralized and decentralized options for water and waste water treatment at community level in India taking into account resource availability, management, treatment solutions, water quality as well as economic, environmental and social factors.

## GEOGRAPHICAL FOCUS WITHIN INDIA

All India.

## CORE BUSINESS

As a leading supplier of products for the solar electronics industry, Steca sets the international standard for the regulation and control of solar energy systems. In the three market segments PV grid connected, PV off grid and solar thermal, the Steca brand is synonymous with innovation and vision. In conception, development, production and marketing, we are committed to the highest quality standards.

Our focus is on made-to-measure solutions for the effective utilisation of solar radiation. Furthermore, we continually examine the technologies we have developed with a view to simple operation and, consequently, usability for the wide base of the population - worldwide.

## LIGHTHOUSE PROJECT

“Mobile PV off-grid system for sales of cold drinks or ice cream near Auroville”

The system mainly consists of a Steca solar refrigerator / freezer PF166, which is powered by only one PV module of 36 cells. During night time, batteries supply 12V DC lights. Local value addition was generated by mounting the components locally on a bicycle. The mobile system is used to sell cold drinks or ice cream to near or distant customers.

The system was financed privately and pays off by its own business concept. Thanks to the outstanding energy efficiency of the Steca PF166, the system only needs 1 PV module and does not need any inverter to power the loads. It proves that energy efficiency helps minimizing system costs.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Steca products are designed to fit the needs of users independently from their geographical location. Our latest solutions revolutionize solar industry by allowing the use of new battery technologies, different module types and complex system configurations. We believe that ecological innovation and economical savings for the users go hand in hand. Therefore, Steca aims to supply our products all over India, in order to help minimizing system costs by increasing energy efficiency.



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*Manufacturer of Solar Charge Controllers, Inverters, Solar Electronics*



Solar ice cream cart, view from above.



Solar ice cream cart, by night.



## Solar Universe India

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*Lamps, Pico Systems, Mobile Charging Stations & Kits, LED Streetlights, Power Packs, On-Off Grid Solar Systems, Central Charging Stations, Micro & Mini Grids, Inverters and Battery Chargers, Hoarding & Billboard Lighting, Garden & Exterior Lamps, Desalination Plants and Water Pumps*



DC home system with LED bulbs, mobile charging kit and table fan in Khoiri Village, India.



With former Chairman, MNRE, Shri Farooq Abdullah at RE Expo in 2011.

## CORE BUSINESS

To sum it up, Solar Universe India is a socially active firm that designs, develops, supplies and installs an array of Solar PV systems for consumers, communities and businesses across Africa, Asia and Europe. Our core business is small & innovative plug and play PV kits that are affordable, convenient and durable. This could include solar lanterns, home lighting or pico systems, mobile & battery chargers and garden lights.

Since we export to a number of countries across the globe, we are also advisers to various governments on their programs and initiatives for rural electrification.

We have been at the forefront for launching newer and more innovative solar systems that are not just pocket friendly and easy to use but also rugged and durable.

## LIGHTHOUSE PROJECT

There are a number of projects that I can think of here but there is this specific customer we worked with recently. A while back I received a mail from a man in a village in Tanzania. He expressed his concern about the lack of electricity for the most basic needs. As ironical as it is, while there are people in the villages there like in our own country who can afford and own mobile phones, they still don't have the means to charge them. He shared how his village folk walk once in two days for 8 km's to charge their phones and he would like to eliminate that by being able to create a unit powered by the sun that would allow up to 15 phones to be charged at one point. This said unit could if possible also meet the basic lighting needs for his work space. With this he would not only solve the problem of his fellow villagers but could also make a small income by charging a minimum amount for each phone charged.

- Size of the project: Retail
- Cost of each unit: \$220
- Finance: Self-Financed

Otherwise, here is a Facebook link (<http://on.fb.me/1xsSz3N>) to one more recent village electrification project close to New Delhi that we did in partnership with a social enterprise and a Canadian technology innovator. We can discuss sizing etc. later if need be.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Within India, we are strongest in North and North East India. We have a network of 75 distributors and channel partners across the country that we work with on B2B basis. Our network reaches to the last mile customer in the foothills of the Himalayas to a fisherman in the Arabian Sea.

With E-commerce becoming the preferred mode of shopping for every tech savvy customer, our revenues from E-commerce alone have touched \$27,000 within 10 months.

## CORE BUSINESS

Suntrace is an independent expert for the development of solar power projects. We cover all major technologies from photovoltaic to solar thermal power. Suntrace was established in 2009 as an independent development specialist for large-scale solar projects. The international management team can look back on 4 GW of power capacity financed, built and operated. The team's background encompasses solar and conventional power business and banking as well as solar research institutions.

The sunbelt countries in Asia, Africa, the Middle East and Latin America are our main markets. Suntrace advises customers from industry, finance and governmental institutions. Our focus is on solar resource, technical performance, bankability and investment structures. Years of power industry and finance experience help us to tackle challenges and hurdles. We are open to engage in skills transfer and local implementation, and also keen to build reliable, trustful partnerships with local and international partners for mutual benefit.

## LIGHTHOUSE PROJECT

SolMap is Suntrace' Lighthouse Project in India under the Indo-German Energy Programme, implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in cooperation with the Ministry of New and Renewable Energies (MNRE). SolMap has main goal to accelerate the planning and implementation of solar power plants in India and increase their power output by mapping solar radiation conditions in India and benchmarking of PV systems in India. Under SolMap project Suntrace supports MNRE in its Solar Radiation Resource Assessment (SRRA) program, under which 115 high precision solar radiation measurement stations have been installed. Suntrace has implemented quality checks, flagging and gap filling procedures of solar radiation data measured by these stations. Project developers use these data to estimate solar radiation resources.

Another aim of this project is to develop new and improved solar radiation map of India using satellite-based solar radiation data in combination with ground-measured data from SRRA stations. These maps will allow identification of locations where various solar energy systems are of greatest use.

The total project cost of SolMap project is 1.6 million Euro, which is financed by the German Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety (BMUB) through the International Climate Initiative (IKI).

## GEOGRAPHICAL FOCUS WITHIN INDIA

Our subsidiary office is based in New Delhi, India and we have projects throughout India. Being part of the SolMap project where the stations are spread in different parts of the country, we know the country very well in and out. We have been working for various clients in India in the states of Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka etc.



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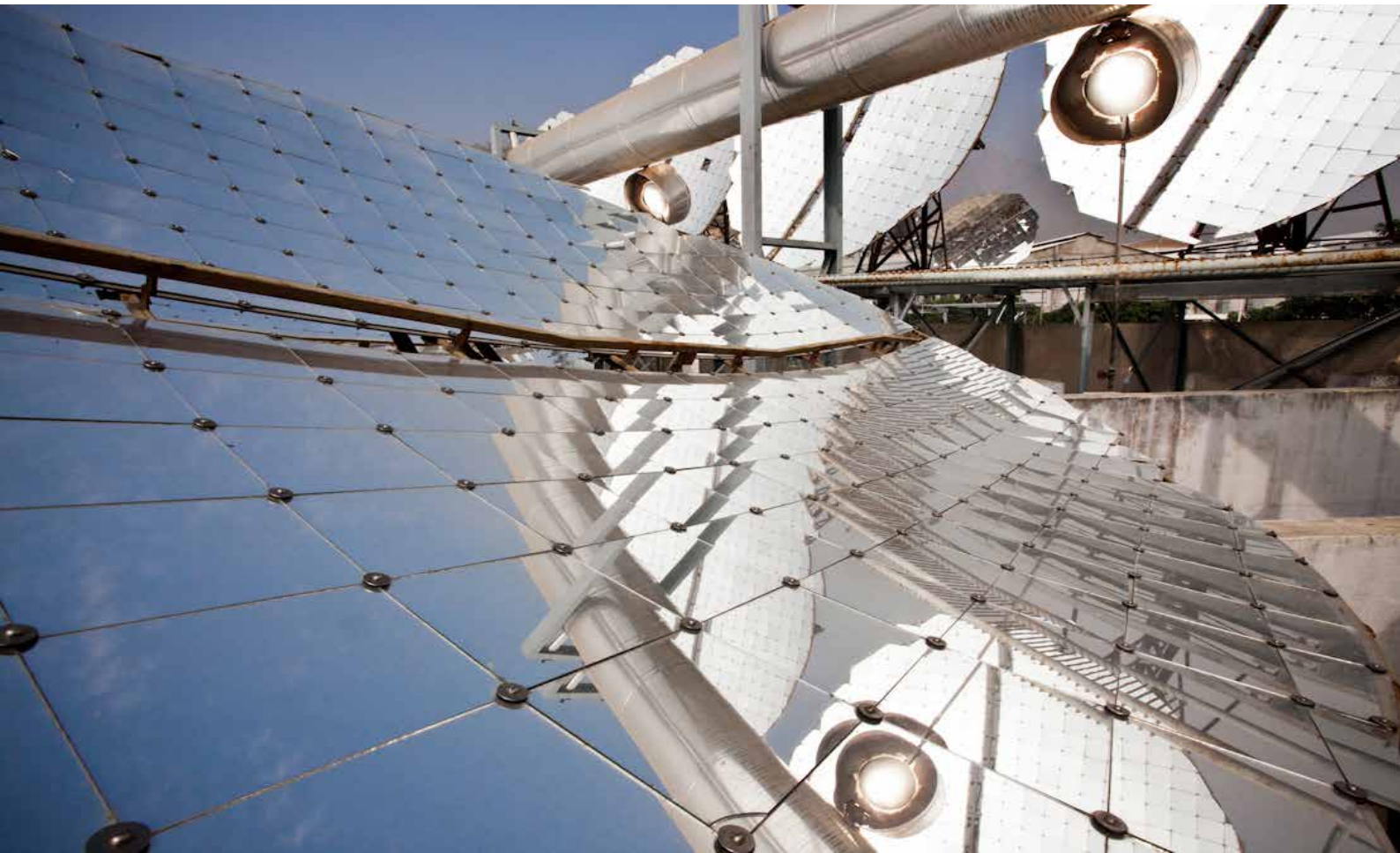
*Solar Project Development Advisory Services, Solar Radiation Resource Assessment, Techno-Economic, Financial, Market and Policy Related Advisory Services*



An illustrative SRRA station with solar radiation and ambient meteorological parameters sensors.



The 2-axis solar tracker with a pyrheliometer, an absolute cavity radiometer, a pyranometer and a shaded pyranometer



## SOLAR THERMAL

## CORE BUSINESS

Industrial Solar GmbH focuses on the market for solar process heat and cold. With different types of collectors, the company offers different industry solutions. With the thermal capacity of approx. 100 kW up to several MW their air- and Fresnel-collectors closes the gap between small solar panels and solar thermal power plants for a number of industrial markets and applications.

## LIGHTHOUSE PROJECT

Since June 2014, a Fresnel collector field with 2,472 kWth feeds into the district cooling system of MTN Group in its headquarters in Johannesburg, South Africa. The concentrating solar thermal plant powers a double-effect absorption chiller with a cooling capacity of 330 kW mainly supplying the server rooms / data centre at the MTN head office.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Our Fresnel-Collector is most suitable in regions with high direct irradiation whereas our air-collector can be used in all regions in India as this technology uses the direct and indirect irradiation.



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*Solar Process Heat (Steam, Hot Water, Thermal Oil), Solar Cooling, Solar Power, Solar Polygeneration*



Fresnel Collector (LF 11) serves the district cooling plant of MTN Headquarter in South Africa.



Air-Collector (Sun-Storm) serves a drying process at Pfizer in Germany.

## CORE BUSINESS

Solarlite CSP Technology GmbH, from the German federal state of Mecklenburg-Western Pomerania, designs and builds solar thermal parabolic trough power stations (concentrated solar power) and process heat plants. For the first time worldwide, Solarlite is using direct steam generation commercially in a power plant. Solar thermal facilities offer the most sustainable form of energy recovery in terms of the environment, resources and availability. The technology has the advantage that as direct solar radiation increases, so does the efficiency of the facilities. The facilities are also characterised by a high degree of flexibility. They can be combined with all other fossil and renewable energy sources and are thus base-load capable. Another plus is the option of producing electricity and process heat at the same time or independently of one another. In addition, the residual heat can be used for further industrial applications for example desalination and cooling.

## LIGHTHOUSE PROJECT

“5 MWe solar thermal power plant in Kanchanaburi, Thailand”

TSE1 is the first commercial solar thermal parabolic trough power plant in the world based on direct steam generation. This unique commercial technology concept uses water instead of the commonly used thermal oil as a heat transfer fluid. The Solarlite parabolic trough SL 4600 is designed for operating temperatures up to 400°C. The operational concept of direct steam generation makes a great contribution to reducing CO2 emissions.

Solar thermal power plants are generally built from a power plant size of 50 MWe. Based on a flexible modular concept, Solarlite is already building power plants on a scale of 500 kWe up to over 30 MWe. Project sizes over and above this are possible.

The project originated based on the Thai feed-in tariff legislation for Very Small Power Producers (VSPP). The law guarantees an additional compensation for electricity fed into the grid for projects up to 10 MWe in scale for the following 10 years after commissioning.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Regions with high direct solar irradiation.



## Solarlite CSP Technology GmbH

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*Solar-Generated Process Heat, Power Generation, Process Steam for Industries, Process Heat for the Chemical Industry, Parabolic Trough Technology, Direct Steam Generation, Concentrated Solar Thermal, Concentrated Solar Power, Solar Enhanced Oil Recovery, Solar Desalination, Solar Cooling*



TSE1 – The first commercial solar thermal parabolic trough power plant in the world based on direct steam generation.



TRESERT - Tri-Generation facility in Thailand generating heat, electricity and cooling using solar energy in combination with biomass.



**SunOyster Systems GmbH (SOS)**

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*CPVT Technology - Concentrated PV with Thermal Energy*

**CORE BUSINESS**

SOS manufactures the SunOyster: A solar technology, concentrating the direct radiation on a focus line where the energy is at the same time converted with an efficiency of 30% into electricity and with an efficiency of 45% into heat (totally 75% efficiency). The heat of up to 170°C can be used as industrial process heat or can be converted into cold (solar cooling).

**LIGHTHOUSE PROJECT**

A lighthouse project planned in India is the installation of 20 SunOysters of 5 kW electrical and 7.5 kW thermal each on the roof of a building. The 100 kWel supply the own demand and are fed into the grid. The heat of 170° C is first powering an ORC machine cum heat storage, adding another 10° of electric efficiency with base load capability, and then driving a double stage absorption chiller.

**GEOGRAPHICAL FOCUS WITHIN INDIA**

All India.



SunOyster 16.



SunOyster 16 mirror with receiver and focus line.





## OTHER INDUSTRIAL SECTORS

**CORE BUSINESS**

Our core business is to find the most efficient way for our customers to acquire energy. The service we are providing is a one stop shop service for energy efficiency. Starting from energy consulting, cost and feasibility studies we are experienced in planning, building and operating power generation systems. Projects in the energy sector can be expansive and are likely to be financially intensive. Our project management capability, proven in many automotive aerospace and energy projects gives us great confidence. Therefore we are ready to fund energy projects if necessary.

To wrap it up: P3 Energy & Storage is able not only to find the best way to acquire energy but also to build, operate and fund energy systems.

**LIGHTHOUSE PROJECT**

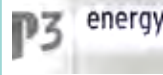
“Establishing an energy efficiency concept in a steel mill in China”

Identified Problems: Very high energy acquisition costs. No energy saving concepts. No energy recovery concepts. No energy awareness.

Solution: After extensive analysis and detailed energy concepts decision was taken for an organic rankine cycle (ORC) energy recovery facility.

**GEOGRAPHICAL FOCUS WITHIN INDIA**

P3 Group has Offices in Bangalore and operates all over India.



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*Energy Efficiency, Transparency and Energy Management Systems, Decentralized Power Generation Systems, Cost and Feasibility Studies*



Energetic optimization of a steel mill in China.



## QINOUS GmbH

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*System Integrator and Solution Provider, Plug-and-Play, Battery Energy Storage, Lithium-Ion, Sodium-Ion, Diesel Hybrid Systems, Photovoltaic, Wind, Hybrid Control*



QINOUS 20ft container interior view.



QINOUS 10ft container lithium-ion energy storage solution with 100kW/112kWh.

## CORE BUSINESS

QINOUS provides smart plug-and-play energy storage solutions for diesel hybrid systems, peak shaving and grid regulatory services in the range from 50 kW to 5 MW. The system is based on lithium-ion or sodium-ion batteries, and includes the complete energy management and hybrid system control for active control of batteries, diesel generators, photovoltaic systems and wind turbines.

QINOUS applies pre-selected and tested components to ensure high system quality and performance. All components are integrated into marine-grade container housings to avoid dust, moisture or saline air intake for lower O&M costs and ensure a long system lifetime. QINOUS also applies a standardized system setup to achieve high reliability and best cost competitiveness through scalability.

The complete system is pre-installed and factory tested before shipment to the site. Upon arrival the power and communication links are simply connected to the containers and the system is ready to operate. Monitoring and control of complete system is carried out on site via a graphic display at the container and remotely via a web interface. It is truly a smart plug-and-play solution.

## LIGHTHOUSE PROJECT

A demonstrator system is setup in Berlin which consists of sodium-ion batteries (30 kW / 80 kWh), lithium-ion batteries (100 kW / 112 kWh), a 150 kW diesel generator, a 100 kW photovoltaic simulator, and a 100 kW load simulator. The batteries are used to form the grid and the diesel generator is only switched on when battery level is low and when there is no energy from the photovoltaic system. The system is able to reduce diesel fuel consumption by 50-80% depending on the load profile.

Another lithium-ion battery storage is installed in a factory building in Germany for load shifting and increasing self-consumption from a roof-top photovoltaic system. The system consists of two battery racks with each 56 kWh and one battery inverter with 100 kW. The system is grid connected; hence next to the battery management, the energy management system further provides voltage and frequency regulation to the production facility to improve the overall grid quality.

The expected payback time for the system is around 8-10 years in that particular case. Faster payback times of 5-8 years can be achieved in other industry applications and in remote areas with diesel replacement applications.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Our target areas are remote locations which use diesel generators as power source, but also commercial and industrial areas suffering from weak grids and frequent brown outs, and which want to integrate a larger share of renewable energies.

## CORE BUSINESS

Simon, Evers & Co. GmbH (SECO) is a traditional Hanseatic trading company with focus on niche applications of highest technological demand. Among those, SECO has earned itself an excellent reputation in future-oriented biotechnology as well as green energy with production equipment related to the reduction of CO2 and the preservation of natural resources. Especially production equipment for the wind energy industry played an important role in this demanding and challenging business.

Today Simon, Evers & Co. GmbH provides solutions in wind turbine production equipment, grid distribution equipment, material surface finishing processes as well as air purification technology and reactive resin products for special building applications.

## LIGHTHOUSE PROJECT

“Supply of a special purpose drilling and cutting machine for processing of 7 MW wind rotor blades in a single setup”

The precise machining of the finished molded wind power blade is a crucial step in the production of those cost intensive components. The machine supplied to the largest wind power blade manufacturer in Korea enabled them to machine blades of up 85m length for offshore application in one single setup. The machine can be equipped with different tools for saw cutting, milling and drilling of the interface area of the blade, which connects to the actual hub of the wind power system.

## GEOGRAPHICAL FOCUS WITHIN INDIA

Pan India focus.



### Simon, Evers & Co. GmbH

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*Wind Turbine Production Equipment, Sea Cable Production Equipment, Material Surface Finishing Processes, Air Purification Technology, Building Materials*



SECO House in Hamburg, Germany.

## About Indo-German Energy Forum

### Background and Objectives

To enhance and deepen the cooperation between India and Germany in the energy sector, the German Chancellor Dr. Angela Merkel and the Indian Prime Minister Dr. Manmohan Singh established the Indo-German Energy Forum (IGEF) at the Hannover Fair in April 2006.

The main objectives of the IGEF are

- to rehabilitate and modernise thermal power plants
- to encourage the use of clean energy sources
- to disseminate climate-friendly technologies on the energy supply and demand side.

The dialogue focuses on exchanging knowledge, promoting private sector activities and putting in place an enabling environment to further develop the markets for efficient thermal power plant technologies, energy efficiency and renewable energies in India and Germany.

### Partners, Institutional Structure and Projects

The high level steering committee of the IGEF, also called the "Forum", takes place annually and provides a platform for high-level policy makers and representatives from industry, associations, financial institutions and research organizations from both India and Germany. On a working level, thematic sub groups have been created which convene meetings on a regular basis:

- Efficiency Enhancement in Fossil Fuel Based Power Plants
- Renewable Energies
- Demand-Side Energy Efficiency and Low Carbon Growth Strategies.

Within the sub groups, several task forces have been set up to devise and implement specific cooperation projects, such as the harmonisation of tender documents for the rehabilitation and modernization of thermal power plant, the Excellence Enhancement Centre for the Indian power sector or the development of an energy performance assessment tool for residential buildings. Additional task forces concerning further topics may be created at the initiative of representatives of the relevant government agencies, private sector and other experts. The Indo-German Energy Symposium provides energy experts from India and Germany a platform for technical exchange and has given further momentum to the bilateral dialogue. The Symposium takes place on a biannual basis and covers aspects of financing, project development, best practices as well as innovative technologies and policy issues.

## **NEW DELHI**

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