SMART SYSTEMS FOR SOLAR POWER

Independent PV Power Supply for Villages in Remote Areas
IBC SOLAR – a company with a tradition

- More than 30 years of experience and know-how
- More than 400 highly-qualified and motivated employees world-wide
- More than 1.7 GW in more than 120,000 reliable PV systems world-wide
IBC SOLAR – range of competence

- On Grid & Off Grid
- Distributor & EPC (engineering, procurement & construction)
- National & International
IBC Solar - your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

- Development
- Contracting & sales
- EPC (engineering, procurement, construction)
- Training, operation & maintenance
IBC Solar- your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

- **Development**
  - Consulting and planning
  - Site inspection
  - Feasibility study
  - Energy use analysis
  - Recording of site weather data

- **Contracting & sales**

- **EPC (engineering, procurement, construction)**

- **Operation & maintenance**
### Development

At the beginning are the customer requirements

...experienced and professional partner for the implementation of the new renewable based energy system, who should be

- Experienced with off-grid system and remote locations (& cultural challenges)
- Provide a system that is feasible for marine conditions
- Not just supply the system but also lead the installation process and training of local staff in understanding the system, maintenance and simple troubleshooting
- Able to provide support after the installation process to ensure the successful long term operation of the system
Development
Project location
Development

Location – as is analysis

- Water tanks 1-7
- Research officer
- Island Manager
- Salt water pump
- Hospital
- Research block
- Generator house
- Shop, store, workshop
- Water tower
- Accommodation block
- Boat shed
- Fish cleaning shed
- Rangers/Assistance research officer block
- Staff house No. 1-6
- Gym
- Garden
- Staff house 1st generation
- Houses 2nd generation (Timber log)
Development
Location – as is analysis – barrels of fuels
Development
Location – as is analysis – diesel generator 20kVA - power total - average value

Logfile -diesel generator 20kVA - power Total - average value
Development
Location – as is analysis - climate data

Climate data by METEOTEST
## Development

### System Simulation (1)

#### System architecture

<table>
<thead>
<tr>
<th>Component</th>
<th>Power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV Array</td>
<td>24 kW</td>
</tr>
<tr>
<td>Generator 1</td>
<td>20 kW</td>
</tr>
<tr>
<td>Generator 2</td>
<td>20 kW</td>
</tr>
<tr>
<td>Battery</td>
<td>96 moll OPzV.solar 2200</td>
</tr>
<tr>
<td>Inverter</td>
<td>30 kW</td>
</tr>
<tr>
<td>Rectifier</td>
<td>30 kW</td>
</tr>
</tbody>
</table>

#### Electrical

<table>
<thead>
<tr>
<th>Component</th>
<th>Production (kWh/yr)</th>
<th>Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV array</td>
<td>37,806</td>
<td>92%</td>
</tr>
<tr>
<td>Generator 1</td>
<td>3,240</td>
<td>8%</td>
</tr>
<tr>
<td>Generator 2</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>41,046</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Monthly Average Electric Production

![Graph showing monthly average electric production](image)
# Development

## System Simulation (2)

### Loads

<table>
<thead>
<tr>
<th>Load</th>
<th>Consumption (kWh/yr)</th>
<th>Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC primary load</td>
<td>29,930</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>29,930</td>
<td>100%</td>
</tr>
</tbody>
</table>

### PV

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>24.0</td>
<td>kW</td>
</tr>
<tr>
<td>Mean output</td>
<td>4.32</td>
<td>kW</td>
</tr>
<tr>
<td>Mean output (kWh/d)</td>
<td>104</td>
<td>kWh/d</td>
</tr>
<tr>
<td>Capacity factor</td>
<td>18.0</td>
<td>%</td>
</tr>
<tr>
<td>Total production</td>
<td>37,806</td>
<td>kWh/yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum output</td>
<td>0.00</td>
<td>kW</td>
</tr>
<tr>
<td>Maximum output</td>
<td>22.7</td>
<td>kW</td>
</tr>
<tr>
<td>PV penetration</td>
<td>126</td>
<td>%</td>
</tr>
<tr>
<td>Hours of operation</td>
<td>4,420</td>
<td>hr/yr</td>
</tr>
</tbody>
</table>

![PV Output Chart](chart.png)
**Development**

**System Simulation (3)**

**Generator (2x 20 kW, only one generator is producing)**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours of operation</td>
<td>164</td>
<td>hr/yr</td>
</tr>
<tr>
<td>Number of starts</td>
<td>19</td>
<td>starts/yr</td>
</tr>
<tr>
<td>Operational life</td>
<td>91.5</td>
<td>yr</td>
</tr>
<tr>
<td>Capacity factor</td>
<td>1.85</td>
<td>%</td>
</tr>
</tbody>
</table>

**Generator 1 (Generator 2 as backup)**

- **Electrical production**: 3,240 kWh/yr
- **Mean electrical output**: 19.8 kW
- **Min. electrical output**: 12.2 kW
- **Max. electrical output**: 20.0 kW

**Fuel consumption**
- **Value**: 1,072 L/yr
- **Specific fuel consumption**: 0.331 L/kWh
- **Fuel energy input**: 10,553 kWh/yr
- **Mean electrical efficiency**: 30.7 %
## Development

**System Simulation (4)**

### Battery

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>String size</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Strings in parallel</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Batteries</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Bus voltage (V)</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal capacity</td>
<td>315</td>
<td>kWh</td>
</tr>
<tr>
<td>Usable nominal capacity</td>
<td>157</td>
<td>kWh</td>
</tr>
<tr>
<td>Autonomy</td>
<td>46.1</td>
<td>hr</td>
</tr>
<tr>
<td>Lifetime throughput</td>
<td>613,623</td>
<td>kWh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy in</td>
<td>21,576</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Energy out</td>
<td>18,447</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Storage depletion</td>
<td>82.8</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Losses</td>
<td>3,047</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Annual throughput</td>
<td>20,008</td>
<td>kWh/yr</td>
</tr>
<tr>
<td>Expected life</td>
<td>18.0</td>
<td>yr</td>
</tr>
</tbody>
</table>

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IBC Solar- your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

Development

Contracting & sales
- Profitability analysis
- Project costing
- Contract management

EPC (engineering, procurement, construction)

Operation & maintenance
Contracting, sales & profitability analysis

Return on invest consideration (sample)

Total costs of PV system compared to fuel generator system

- Costs Fuel Gen.
- Costs Hybrid

Time in years

Costs in PHP

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IBC Solar - your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

Development → Contracting & sales → EPC (engineering, procurement, construction) → Operation & maintenance

- Quality management
- Technical detail planning
- Procurement and logistics
- Turnkey construction
- Commissioning
- Project acceptance
Technical detail planning & EPC
Planning of PV construction and power house
Technical detail planning & EPC Planning
Technical detail planning & EPC

Implementation

- Civil work on the solar structure and power house
- Mounting of the solar panels
- DC cabling and PV junction box to the power house
- Integration of the diesel generator
- Installation of the battery
- Installation of the string inverter and stand-alone inverter
- AC cabinet and the monitoring system
- Electrical works to the existing buildings
- Testing and Commissioning
- Implementation
- Technical detail planning & EPC
Technical detail planning & EPC

Implementation
IBC Solar - your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

- Development
- Contracting & sales
- EPC (engineering, procurement, construction)
- Operation & maintenance
  - Monitoring
  - Technical management
  - Training
  - Full-service package
Training, operation & maintenance

Training
Training, operation & maintenance
Monitoring, operation & maintenance
Training, operation & maintenance
Monitoring, operation & maintenance
IBC Solar- your partner for off-grid projects
PV Off-Grid solutions – the full range of certified off-grid products

Project Key Data – 25kWp PV-Diesel-Hybridsystem

- Diesel power
  - 20 kVA
  - 20 kVA (for backup)
- PV
  - 108 x 235 Wp modules
  - Total area of solar generator 176 sqm
  - Total cable length – 1300 m
  - Inverters – 3 x STP8000TL and 6 x SI5048
  - Batteries – 96 x 12OPzV.solar 2200, 2V
  - Shipment weight – around 20 tons
IBC Solar - your partner for off-grid projects

Our capabilities: Planning and implementing off-grid projects

Development
Contracting & sales
EPC (engineering, procurement, construction)
Training, operation & maintenance
IBC Solar - your partner for off-grid projects
A complete system solution
THE OUTLOOK: SUNNY

Nils Szymczak
PV Off-Grid Power Supply Sales Manager

IBC SOLAR AG
Am Hochgericht 10
96231 Bad Staffelstein
Germany

Web     www.ibc-solar.com
Email   nils.szymczak@ibc-solar.de
Mobile  +49 (0)172-82 41 578
Phone   +49 (0)9573-92 24 538
Fax     +49 (0)9573-92 24 98538