Energy Management Solutions for MNO’s and Tower Companies

Value proposition

2013
### Company Overview

#### OVERVIEW

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>1995</td>
</tr>
<tr>
<td>Acquisition of P21</td>
<td>2011</td>
</tr>
<tr>
<td>Business</td>
<td>Energy Management Systems, Clean Energy, Training &amp; Research</td>
</tr>
<tr>
<td>Markets</td>
<td>&gt; 70 countries, Export ratio 60-80%</td>
</tr>
<tr>
<td>Locations</td>
<td>Berlin, Munich, Vancouver, Dubai, Nairobi, Johannesburg</td>
</tr>
<tr>
<td>Group HQ</td>
<td>Berlin</td>
</tr>
<tr>
<td>Main shareholders</td>
<td>Bmp AG, Conduit Ventures, UK, NTEC, Kuwait, Ruffer European Fund, UK</td>
</tr>
</tbody>
</table>

#### GROUP STRUCTURE

- **Heliocentris Energy Solutions AG**
  - 100%
  - Berlin

- **Heliocentris Academia GmbH**
  - 100%
  - Berlin

- **Heliocentris Industry GmbH**
  - 100%
  - Berlin, Munich, Johannesburg

- **Heliocentris Americas Inc.**
  - 100%
  - Vancouver

- **Heliocentris Energy FZE**
  - 100%
  - Dubai

### CLIENTS
Our Solutions Address the Customer’s Pain Points

Increased Cost Pressure

Competition

Climate Change

Efficient & Clean Energy Solutions at a Reduced Total Cost of Ownership

INCREASE
Network Availability

REDUCE
Energy & Maintenance Cost (OPEX)

OPTIMIZE
CAPEX

MINIMIZE
Carbon Footprint
Changing the Energy Landscape

We develop, manufactures and delivers Energy Management Systems

We design, implement and operate Turnkey Power Solutions for Partners and End-Customers.

TODAY
- Offgrid energy supply mainly via diesel generators
- Only limited management required
- Low complexity as well as low efficiency setup

ENERGY GENERATION
- Diesel Generator
- PV
- Wind
- Fuel cell
- Diesel
- Battery
- Electrolyser/ H2 Storage

ENERGY STORAGE

MANAGEMENT
- Management Monitoring Control

TOMORROW
- Energy supply becomes hybrid to leverage strengths of various technologies and to
  - increase efficiency
  - become green
- Energy supply becomes intelligent to
  - reduce Maintenance Cost
  - Increase uptime

Offgrid energy supply mainly via diesel generators
Only limited management required
Low complexity as well as low efficiency setup

Energy supply becomes intelligent to
- reduce Maintenance Cost
- Increase uptime
Site & Power Management Overview

1. Site management
2. Power management

- Reduced CAPEX & OPEX
- Improved ROI
Integrated Energy Site Management System

Architecture overview

NETWORK OPERATIONS CENTER
Monitoring / Operation (RMS)
Remote Site Configuration
Management Server
GPRS / 3G / TCP-IP
SMS
Energy Manager
Battery Genset Fuel Tank PV Wind Cooling Site Security Grid
Site x
Site y

Integrated Energy Site Management System
Heliocentris Core Competences define the Managed Power Solution

System Design and Integration

Managed Power Solutions

Power Components, Testing and Qualification

EMS Energy Management System
Managed Power Solutions

Solutions to help you take the lead.

We provide turnkey installations for
- Genset Efficiency
- Solar Hybrid
- Bad Grid Box

Our turnkey Managed Power Solutions consist of

Power Components
- Batteries
- Rectifiers
- Cooling
- PV
- and more…

Energy Management Feature Modules

Monitoring & Control
- Genset Management
- Battery Management
- Fuel Monitoring
- Site Security
- and more…
## Modular Clean Energy Solutions for all grid and site types

<table>
<thead>
<tr>
<th>Solutions</th>
<th>Components</th>
<th>Site Type</th>
<th>Grid Type</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>New Site</td>
<td>Retrofit</td>
</tr>
<tr>
<td>Genset Efficiency</td>
<td>EMS, Genset, Batteries, Battery Cabinet, Rectifier</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Grid Cube</td>
<td>EMS, Batteries, Battery Cabinet, Rectifier</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Solar Hybrid + Genset</td>
<td>EMS, Genset, Solar panels, Solar Charger Batteries, Battery Cabinet, Rectifier</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Pure Solar 24+</td>
<td>EMS, Solar panels, Solar Charger, Batteries, Battery Cabinet, Rectifier</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H2-Extention</td>
<td>EMS, Fuel Cell, Batteries, Battery Cabinet, Rectifier</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lithium powered Sites</td>
<td>EMS, Li-Batteries, Battery Cabinet</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Customer defined Business Models
Customer Responsiveness by Business Model

- **OPEX**
- **CAPEX**
- **PAY-BACK**

-> **Commerical Preference**

  + **Site Specific Topology**

  + **Commercial & Technical Solution Engineering**

== **CUSTOMER SPECIFIC & OPTIMIZED PROJECT BUSINESS CASE**
### Heliocentris Business Models

#### EMS Turnkey (CAPEX + O&M)
- Energy Manager
- Batteries
- Energy Manager O&M
- Rectifiers
- Generators
- Site O&M
- Fuel Delivery
- Fuel Procurement

#### Power Solution Turnkey (CAPEX + O&M)

#### Power Supply Turnkey (CAPEX + O&M + Fuel)

#### Available within an OPEX model (OPEX)

*Mobile Network Operator / TowerCo*
CAPEX Model

- MNO/MNO/TowerCo invest all CAPEX either from its own source or from capital market, therefore financial risk belongs to MNO/TowerCo
- IRR and NPV of Green Power deployment is significantly more attractive
- For volume deployment, CAPEX investment can be a barrier since it require large investments and might be in conflict with other investment priorities.

OPEX Model

- MNO/TowerCo does not have to invest for CAPEX, therefore no financial risk to deploy green power.
- IRR and NPV increases for telecom site since site OPEX reduces
- CAPEX can be released for other telecom investments.
- With mass deployment, the business opportunity for the Energy provider becomes more viable.
Business Model Concepts with Heliocentris

PPA - Power Purchase Agreement
MFP - Monthly fixed payment
ESA - Energy Savings Agreement

Managed Power Solutions Company
(e.g. Heliocentris)

→ Limit or eliminate Investments
→ Outsource Risks
→ Outsource Ownership (Lean Asset)
A major cost saver is proper Site Management

Saves a lot more than you think.
Site Management enables

- Benchmarking to determine savings potential
- TCO analysis and optimization potential
- Increased site uptime through fix before fail and fix on first visit
Centralized site monitoring enables benchmarking

Centralized Remote Management Server

Site
TCO Analysis: Drivers

**Battery**
- High CAPEX, needing replacement after 2.5-5 years
- Life cycle depends on ambient conditions and maintenance
- Life cycle depends on depth of discharge regime
- Defective cell replacement can mean string replacement
- No monitoring, no manufacturer warranty

**Genset**
- Delivered fuel cost
- Partial load efficiency / rectifier sizing
- Maintenance

**Aircon**
- High temperature, low efficiency
- Significant site electricity consumption
- Two units needed, high CAPEX
- Cleaning filters
Battery
- High CAPEX, needing replacement after 2.5-5 years
- Life cycle depends on ambient conditions and maintenance
- Life cycle depends on depth of discharge regime
- Defective cell replacement means string replacement
- Monitoring for manufacturer warranty

Genset
- Delivered fuel cost
- Partial load efficiency
- Maintenance
- Discover anomalies

Aircon
- High temperature, low efficiency
- Significant site electricity consumption
- Two units needed, high CAPEX
- Cleaning filters

Site Management: Sit-in-network housekeeper
- Monitor temperature
- Roll over to manufacturer
- Monitor inlet/outlet temperature
Savings: Battery temperature monitoring

Typical field observation when monitoring becomes available for first time

Battery lifetime as a function of temperature

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Type</th>
<th>Block battery</th>
<th>Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12V 3PVV 210</td>
<td>5PVV 350</td>
</tr>
<tr>
<td>40°C, 104°F</td>
<td>Cycles</td>
<td>2.100</td>
<td>3.150</td>
</tr>
<tr>
<td>25°C, 77°F</td>
<td>Cycles</td>
<td>3.360</td>
<td>5.040</td>
</tr>
<tr>
<td>20°C, 68°F</td>
<td>Cycles</td>
<td>4.200</td>
<td>6.300</td>
</tr>
</tbody>
</table>

Price of 600 AH battery
6000 USD

50% difference for cycles between 20°C and 40°C
Value impact: Fuel consumption

Fuel consumption for sites with 15 kVA genset 1,500 Liters/month/site

1. Analyze consumption
2. Take measures

15% of fuel saved in region C

Total savings from benchmarking
22,500 USD/month (1 ltrs = 1 USD)
270,000 USD/year

Cost for fuel monitoring per site: 2400 USD
300 sites at 720,000 USD
Payback ~ 2.7 years
Fuel theft by insiders, leading indicators

**Fuel theft by insiders**

- Maintenance visits with disabled fuel sensors
- Pattern: theft occurs shortly after refill
- Hybrid cycle disabled for suspicious reasons

**Best Practice**

- Separate RMS oversite from ground crew
- Predict fuel consumption based on runtimes
- Send in outside team to verify obscure errors
- Change filling routines regularly

**Theft**

- within distributor or in transit.

**Operator estimates**

- 10% of fuel costs due to theft
- 50% in extreme cases

**Actual 50%**

**Estimate 10%**
Refilling on demand reduces truck rolls

Accumulated fuel consumption

“Fuel Refill Event” message to RMS

Compare plan / actual

“Let them know that you know”
Benefits centralized fuel measurement

Live Centralized Reporting
Prevent, respond, calculate

- Transportation cost
- Theft control
- Fill as late as possible
- Reduce truck rolls
- Leakage
- Avoid fines
Site Management enables

- Benchmarking
- TCO analysis
- Service Optimization

Monitoring comes at a price, not monitoring comes at a cost.
Service optimization

Prevent, respond, optimize with Live Centralized Monitoring

- Optimize dispatch
  Routine, preventive and emergency
- Monitor genset runtimes, refueling and maintenance
- Send right person to fix issue – save travel time
- Fix before fail – reduce outage time
- Monitor ambient temperature

Cutting travel and outage time

**Fix on first visit**
With remote analysis send the right person with the right part

**Fix before fail**
Saving: Dispatch during working hours

Fuel and battery theft

1. **12:17** | Scheduled fuel refill at site (100 l)
2. **00:23** | Remote Management Server Alarm: Fuel theft & genset starter battery failure
   - Energy Manager data confirmed >14h hybrid-battery runtime left
   - Field service was dispatched for standard working hours
3. **14:00** | Field service replaced genset starter battery and fuel

**Measures planned to reduce/prevent fuel theft (alarm at site, authorities):**

- Full site transparency
- Hybrid-battery optimization
- Saves cost for emergency services
- Radio-services were never interrupted

Bring spare starter battery
### Key Benefits and Savings

<table>
<thead>
<tr>
<th>CUSTOMER UTILITY</th>
<th>BENEFITS</th>
<th>SAVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Theft Detection</td>
<td>Fuel loss detection in real time</td>
<td>Up to 50% fuel savings</td>
</tr>
<tr>
<td>Cooling Optimization</td>
<td>Smart aircon control</td>
<td>Site energy consumption</td>
</tr>
<tr>
<td>Site Infrastructure Uptime</td>
<td>Fix site issues remotely or with one site visit</td>
<td>Increased availability of radio services (&gt;99.8%)</td>
</tr>
<tr>
<td>Site Security</td>
<td>Intrusion detection and fuel monitoring</td>
<td>Reduced fraud and vandalism damage</td>
</tr>
</tbody>
</table>
Site Infrastructure Uptime

Predictive and smart maintenance

**GENSET**
*Genset monitoring*
- When starter battery is close to failure
- When genset is overheating
  
  Trigger genset maintenance only as required

**FUEL TANK**
- Refuel tank before empty
- Refill only when required

**SECURITY**
- Intrusion Alarm
- Fire alarm
- Access control

**FIX BEFORE FAIL**

**BACKUP BATTERY**
- Automatic, remote battery monitoring gives early detection of battery cell failures before backup time becomes too short (on-grid sites)
- Optimize battery lifetime with state of charge monitoring for hybrid sites

**AIRCON**
Aircon cooling deterioration detection

**TRANSPARENCY**

**GRID AVAILABILITY**
Availability and quality of the grid
Strategic Roadmap
### Strategic Roadmap

**From Genset Efficiency Solution Today to Complete Zero Emission Solutions Tomorrow**

<table>
<thead>
<tr>
<th>TODAY</th>
<th>TODAY</th>
<th>TODAY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>2</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td>Genset Efficiency Solution</td>
<td>Renewable Hybridization</td>
<td>Zero Emission</td>
</tr>
</tbody>
</table>

- **TODAY**
  - **1** Battery Hybridization
    - Diesel Generator
    - Energy Manager
    - Battery
  
  - **2** Integration of renewable energy sources
    - Smaller Diesel Generator
    - Energy Manager
    - Battery
    - PV
    - Wind

- **TOMORROW**
  - **3** Zero Emission
    - Energy Manager
    - Battery
    - PV
    - Wind
    - Fuel Cell
    - Electrolyzer

**From Genset Efficiency Solution Today to Complete Zero Emission Solutions Tomorrow**

- **TODAY**
  - **1** Battery Hybridization
    - Diesel Generator
    - Energy Manager
    - Battery

- **TOMORROW**
  - **3** Zero Emission
    - Energy Manager
    - Battery
    - PV
    - Wind
    - Fuel Cell
    - Electrolyzer

- **TODAY**
  - **1** Battery Hybridization
    - Diesel Generator
    - Energy Manager
    - Battery

- **TOMORROW**
  - **3** Zero Emission
    - Energy Manager
    - Battery
    - PV
    - Wind
    - Fuel Cell
    - Electrolyzer

- **TODAY**
  - **1** Battery Hybridization
    - Diesel Generator
    - Energy Manager
    - Battery

- **TOMORROW**
  - **3** Zero Emission
    - Energy Manager
    - Battery
    - PV
    - Wind
    - Fuel Cell
    - Electrolyzer
Savings from Helicoentris' Efficiency Solutions
Case Study: Yemen

SAVINGS

Fuel: 4,640 L / 55.2%
CO2: 29,4 Tons per site
Genset runtime savings (Maintenance cost): 72,6%

Savings over a period of 1 year.

Configuration
- Genset Management
- Battery Management
- Diesel Fuel Management incl. Fuel Level Sensor
- Remote Access & Control
- Aircon Management
Case Study: Zimbabwe

SAVINGS

Fuel: 4,640 L / 56.4%
CO2: 12.3 Tons per site
Genset runtime savings (Maintenance cost): 70%

Savings over a period of 1 year.

Configuration
- Genset Management
- Battery Management
- Diesel Fuel Management incl. Fuel Level Sensor
- Remote Access & Control
- Aircon Management
- Free Air Cooling
Case Study: Indonesia

SAVINGS

Fuel: 9,360 L / 54%
CO2: 24.8 Tons per site
Genset runtime savings (Maintenance cost): 70%

Savings over a period of 1 year.

Configuration
- Genset Management
- Battery Management
- Diesel Fuel Management
- Remote Access & Control
- Aircon Management
- Free Air Cooling
PV Monitoring, Mozambique

Customer
Mobile Network Operator from Mozambique

Description
Operator with more than 400 sites across the country, looking for visibility of the energy systems on their sites, e.g. batteries, genset, PV and general alarms.

Project
Site data analysis and reporting through centralised management system to increase site visibility and reliability.

Solution
Energy Manager and a number of Heliocentris Site Management features implemented

Results
The field-based Energy Manager monitored and reported the energy produced by the solar panels. Sites were clearly visible. Site data and corresponding analysis were made available.

Customer value
Visibility of site conditions and all energy systems. Efficient maintenance/logistic planning.
Solar Project Reference (1/2)

Customer
Global Mobile Network Operator, Pakistan Network.

Description
One of the world’s major operators with operations in 11 countries.

Project
Mobile base stations are mainly located in off-grid and bad-grid sites and are operated by diesel gensets. Due to high fuel costs and CO2 emissions the operator is looking for alternative energy solutions.

Solution
Heliocentris has designed and built up a Solar-Hybrid Power Solution based on an existing Genset Efficiency System, integrating existing components with EM.

Scope of work
- System design, civil and mechanical works
- All power and control cabling
- Arrangement of material from local market
- Local sourcing
- Configuration, testing and commissioning
- Activate solar hybrid mode
Solar Hybrid Site Installation

Location
Pakistan
» 2 hours from Islamabad
» 43°C
» Bad Grid / 12 hour outage per day

Site data
900 W Load
» Solar Panel Capacity 3.36 KW
» Battery 500 AH
» Generator 13.5 KVA

Time
Project Time
» Installed in June 2013
» Implementation time 9 days
» Trial time 3 months

Customer value
Visibility of site conditions and all energy systems. Efficient maintenance/logistic planning.
Clean Power Site Demonstration System

Clean Power Site, KISR

Kuwait Institute for Scientific Research, in partnership with KIA.

Design and erection of a Renewable Energy Management Demonstration System.
Solar and wind electricity.

- Energy Manager coordinates energy sources.
- Battery buffers short-term fluctuations and supplies power at night.
- Fuel cell system ensures energy supply during all daily and seasonal circumstances.
- Excess energy of the primary power sources will be converted into hydrogen by an electrolyzer. The hydrogen will be used by the fuel cell to provide power.

Customer value

Visibility of site conditions and all energy systems.
Efficient maintenance/logistic planning.
Diesel Consumption and Runtime per day and site before and after Hybridization

Customer: Hutchison 3 Indonesia
Monitoring & Control Solutions for 116 Backbone Sites
Genset Efficiency (Battery Hybrid) Solutions for 35 Sites
Backbone Sites Monitoring & Control for Hutch’s Backbone

Status as per September 2013: 83 Sites Installed out of 116 sites planned
Realized Savings over all 35 Hybridized Sites

- Solution: Battery Hybridization of Diesel BTS sites
- Actual Number of Hybrid Sites: 35
- Diesel Price on site: 1,30 US$
- Period Examined: 01/01/2011 to 01/07/2013

**Fuel Savings per Year (L)**
- Before: 341,577 L
- After: 155,497 L
- Savings: -54%

**Runtime Savings per Year (h)**
- Before: 306,600 h
- After: 94,458 h
- Savings: -70%

**Savings per Year**
- Fuel Savings: 248,815 $US
- Maintenance Savings (generator related): -70%
- 500 tons of CO₂ emissions avoided per year