# Zhengzhou Hengling New Energy - Solution

# Smart Factory Solution

## Zhengzhou Hengling New Energy Technology Co., Ltd.

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## 1. REQUIREMENT ANALYSIS & INVESTIGATION

### 1.1 Project Background

Industrial manufacturing facilities require lighting solutions that: - Support worker productivity and safety - Reduce energy consumption in 24/7 operations - Integrate with Industry 4.0 automation systems - Withstand harsh industrial environments - Provide data for operational optimization

### 1.2 Stakeholder Requirements

- **Plant Management**: Energy cost reduction, productivity improvement
- **Safety Officers**: OSHA compliance, accident prevention, emergency egress
- **Maintenance Teams**: Predictive maintenance, reduced downtime
- **Operations**: Integration with MES/ERP systems, production optimization
- **Finance**: Quick ROI, predictable operating costs

### 1.3 Facility Parameters

- Facility types: manufacturing, warehousing, logistics, R&D centers
- Area coverage: 5,000m² to 100,000m²+
- Ceiling heights: 4m (offices) to 20m (high-bay warehouses)
- Operating shifts: 1-3 shifts, 5-7 days per week
- Environmental conditions: dust, temperature variations, vibration

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## 2. SOLUTION DESIGN

### 2.1 Industrial IoT Lighting Architecture

**Four-Layer Intelligent System:** - **Perception Layer**: High-bay/low-bay fixtures with integrated sensors - **Network Layer**: Industrial Ethernet/WiFi 6, DALI-2, Modbus protocols - **Edge Layer**: Local processing for real-time control and analytics - **Application Layer**: MES integration, energy management, reporting

### 2.2 Core Technologies

- **High-Bay Optimization**: AI-based lighting for warehouse aisle optimization
- **Occupancy Intelligence**: mmWave radar for accurate personnel detection

- **Machine Sync**: Lighting synchronized with production equipment
- **UWB Positioning**: Asset and personnel tracking integration
- **Energy Analytics**: Real-time consumption and cost allocation

### 2.3 Fixture Portfolio

| Application | Fixture Type | Power Range | Mount Height |
|---|---|---|---|
| High-Bay Warehouse | Linear High-Bay LED | 100W-400W | 8m-20m |
| Production Floor | Industrial Panel Light | 50W-200W | 4m-8m |
| Aisles & Walkways | Linear LED Strip | 20W-80W | 3m-6m |
| Offices & Labs | Recessed Panel | 30W-60W | 2.5m-4m |
| Outdoor Yards | Floodlight / Area Light | 100W-300W | 6m-15m |
| Emergency | Self-Contained Exit Light | 5W-20W | Standard |

### 2.4 System Features

- Zone-based and individual fixture control
- Real-time occupancy and ambient light sensing
- Production schedule synchronization
- Energy metering per department/zone
- Predictive maintenance with failure alerts
- OEE (Overall Equipment Effectiveness) integration
- Emergency lighting testing and compliance reporting

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# 3. PRODUCT CUSTOMIZATION

### 3.1 Industrial Customization

- IP65/IP66 ingress protection for dusty environments
- IK08/IK10 impact resistance for heavy industry
- High temperature rating (-40°C to +65°C)
- Vibration resistance for heavy machinery areas
- Food-grade materials for food processing facilities
- Explosion-proof options for hazardous locations

### 3.2 Integration Customization

- MES/ERP system integration (SAP, Oracle, custom)
- SCADA and PLC communication (Modbus, OPC UA)
- Warehouse Management System (WMS) integration
- Building Management System (BMS) integration
- Custom API development for proprietary systems

- Energy management platform integration

### 3.3 Energy Configuration

- Grid-tied with energy metering and sub-billing
- Solar PV integration for on-site generation
- Peak demand management and load shedding
- Power quality monitoring and protection
- Energy storage integration for demand response
- ISO 50001 energy management compliance

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# 4. PROJECT IMPLEMENTATION

### 4.1 Phased Implementation

| Phase | Duration | Activities |
|---|---|---|
| Audit & Design | 1-2 weeks | Energy audit, photometric design, integration plan |
| Pilot Deployment | 2-4 weeks | One production line/warehouse zone pilot |
| Full Rollout | 4-12 weeks | Phased installation by production zone |
| Integration | 2-4 weeks | MES/SCADA/BMS system integration |
| Optimization | Ongoing | Continuous improvement based on data |

### 4.2 Installation Best Practices

- **Production Disruption Minimization**: Off-shift installation, phased rollout
- **Safety Protocols**: Lockout/tagout, fall protection, confined space
- **Cable Management**: Industrial trunking, proper grounding, EMI protection
- **Network Infrastructure**: Industrial grade switches, redundant paths
- **Documentation**: As-built drawings, cable schedules, test reports

### 4.3 Compliance Standards

- OSHA 29 CFR 1910 workplace lighting
- IESNA RP-7 industrial lighting standards
- NFPA 70 National Electrical Code
- IEC 61508 functional safety
- ISO 14001 environmental management
- CE, UL, DLC certification for all fixtures

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# 5. SYSTEM COMMISSIONING & TESTING

## 5.1 Functional Testing

- Individual and group control verification
- Sensor calibration and range testing
- Dimming range and response time
- Emergency lighting activation and duration
- Integration communication protocol testing

## 5.2 Performance Validation

- Photometric verification (lux levels, uniformity)
- Energy consumption baseline measurement
- 72-hour continuous operation test
- Network reliability and failover testing
- Cybersecurity assessment for connected systems

## 5.3 Acceptance Criteria

- Energy savings verification (50%+ target)
- All integration points functioning correctly
- Safety standards compliance verified
- Maintenance staff trained and competent
- Complete documentation package delivered

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# 6. PROJECT DELIVERY

## 6.1 Deliverables Package

- Complete lighting hardware installation
- Central control system with user licenses
- All required system integrations
- Energy monitoring and reporting platform
- Mobile app for facility managers
- Spare parts and maintenance kit

## 6.2 Documentation

- As-built drawings and BOM
- Photometric analysis reports
- Operation and maintenance manuals
- Integration specifications and API docs
- Compliance certificates and test reports
- Energy savings calculation methodology

## 6.3 Training Program

- **Maintenance Teams**: Troubleshooting, component replacement
- **Production Managers**: Zone control, scheduling, reporting

- **Energy Managers**: Analytics, cost allocation, optimization
- **IT Teams**: Network configuration, cybersecurity, integration
- **Safety Officers**: Emergency procedures, compliance reporting

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# 7. OPERATION & MAINTENANCE

## 7.1 Maintenance Strategy

| Approach | Implementation |
|---|---|
| Predictive | AI-based failure prediction, automated alerts |
| Preventive | Scheduled inspection, cleaning, testing |
| Condition-Based | Real-time performance monitoring |
| Corrective | Field service with mobile work orders |
| Optimization | Continuous energy and performance tuning |

## 7.2 Maintenance Schedule

| Frequency | Activities |
|---|---|
| Daily | Automated system health check |
| Weekly | Energy consumption review, alert resolution |
| Monthly | Visual inspection, fixture cleaning |
| Quarterly | Sensor calibration, connection check |
| Semi-annually | Emergency lighting test, firmware update |
| Annually | Full photometric audit, energy savings report |

## 7.3 Continuous Improvement

- Monthly energy review meetings
- Quarterly performance benchmarking
- Annual technology roadmap update
- Production change impact assessment
- Employee feedback integration

## 7.4 Performance Metrics

- Energy cost reduction (target: 60%+)
- Maintenance cost reduction (target: 40%+)
- System uptime reliability (target: 99.9%+)
- Lighting quality compliance (100% target)
- Worker productivity improvement (target: 5-10%)
- ROI achievement (target: 2-3 year payback)

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