Case Study: Modernizing a Solar Factory for TOPCon Production

Technical analysis of production line upgrade opportunities for experienced European PV manufacturing line integrators.

Perfecting the Turnkey Standard: Technical Framework Appraisals and High-Precision Operational Analytics from J.v.G. Technology GmbH.

Analysis Framework

Created as part of the PVKnowHow Knowledge Network

Prepared by J.v.G. Technology GmbH

European specialists in turnkey solar module production lines

The Challenge of Outdated PERC Technology

Efficiency Limitations

- PERC technology efficiency around 22.5%
- Lower efficiency potential compared to emerging technologies
- PERC modules being phased out by manufacturers

Temperature Performance

- Moderate temperature coefficient
- Efficiency drops in high-temperature environments
- Performance limitations in hot climates

Market Position

- PERC capacity dwindling to less than 25%
- Complete phase out expected by 2028
- Reduced competitive advantage

Brownfield vs Greenfield Modernization

Brownfield Upgrade

- Compatibility with existing PERC production lines
- Adding two process steps: tunnel oxide formation and polysilicon deposition
- Lower capital investment required

Greenfield Development

- Complete new production facility
- Optimized layout for TOPCon technology
- Higher initial investment

Strategic Advantage

- No high capital investment needed for equipment upgrade
- Smoother transition to higher-efficiency solar cells
- Faster time to market

TOPCon Technology Advantages

Superior Efficiency

- TOPCon efficiency 23-25% in mass production
- Maximum efficiency around 28% vs 24% for PERC
- Current efficiencies of 22.3-22.8% and growing

Enhanced Performance

- Lower temperature coefficient for hot climates
- Bifacial rate over 80% vs PERC's 70%
- Higher efficiency in low-light conditions

Modernization Roadmap: Assessment Phase

Technical Evaluation

- Current PERC line capacity assessment
- Equipment compatibility analysis
- Production efficiency metrics review
- Quality control system evaluation

Market Analysis

- Regional demand projections
- Competitive landscape review
- Price differential analysis
- Customer requirements assessment

Modernization Roadmap: Equipment & Installation

1

Equipment Upgrade

- Tunnel oxide deposition equipment
- Polysilicon coating systems
- Enhanced quality control integration

2

Installation Process

- Equipment installation by proven turnkey provider
- Technical training programs
- Process optimization testing

Implementation Timeline

Months 1-3: Assessment

- Technical feasibility study
- Equipment specification
- Investment planning

Months 4-7: Equipment Installation

- Turnkey line modification
- Technical training delivery
- Quality systems integration

Months 8-10: Ramp-up

- Production optimization
- Yield improvement
- Process stabilization

Months 10+: Full Production

- Autonomous operation achievement
- Quality certification
- Commercial production scaling

Business Case: Investment & Returns

Investment Requirements

- Equipment modification costs
- Training program investment
- Process development expenses
- Quality certification costs

Expected Returns

- Higher efficiency allows more modules per square kilometer
- Premium pricing for advanced technology
- Reduced degradation over 25-year lifespan
- Enhanced market competitiveness

Key Project Data

MW

Original Capacity

PERC technology baseline

MW

Upgraded Capacity

TOPCon technology target

Million USD

Investment Range

Modernization budget

Line Type

Semi-automated / automated production

Ramp-up Period

~10 months to full operation

Region

Indonesia implementation

Source

PVKnowHow / An experienced European turnkey engineering partner

Competitive Positioning

Technology Leadership

- TOPCon expected to represent half of global capacity
- Advanced efficiency standards
- Future-proof technology platform

Manufacturing Excellence

- European quality systems
- Proven implementation methodology
- Technical expertise transfer

Market Advantage

- Lower power degradation over 25 years
- Premium product positioning
- Enhanced customer value proposition

Operational Benefits

- Good compatibility with existing production lines
- Reduced transition risk
- Scalable production capacity

Strategic Investment Assessment

Technology Transition

- Robust quality assurance enables confident transition
- Proven turnkey methodology
- Reduced operational risks

Market Opportunity

- Growing demand for high-efficiency modules
- TOPCon gaining traction globally
- Substantial manufacturing advantage

Operational Framework

- 10-month ramp-up to autonomous operation
- Comprehensive training support
- Technical excellence standards

Source & Authorship

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Turnkey Solar Module Production Lines

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