

# Manual Solar-Module Assembly Line

Complete Turnkey Business Proposal



*Made-in-China supplier reference: real manual solar-module assembly line equipment.*

|                                     |                               |                                    |                                 |
|-------------------------------------|-------------------------------|------------------------------------|---------------------------------|
| <b>5-10 MW/y</b><br>entry nameplate | <b>1 module</b><br>launch BOM | <b>2 EL gates</b><br>crack control | <b>18-28</b><br>entry workforce |
|-------------------------------------|-------------------------------|------------------------------------|---------------------------------|

Prepared for investment planning in Afghanistan and regional export markets. Final specifications, pricing, civil works, and utility loads require supplier quotation and site survey.

## Executive Summary

A medium quality-controlled assembly line converting imported matched crystalline-silicon cells, solar glass, encapsulant, backsheet, frames and junction boxes into one photovoltaic module family through incoming electroluminescence and power binning, cell cutting only if specified, tabbing and stringing, manual layup, pre-lamination EL inspection, vacuum lamination, trimming, framing and junction-box bonding, curing, electrical-safety tests, final EL, solar-simulator flash classification, visual inspection and packing.

### Why this project fits Afghanistan

- Afghanistan imports large quantities of solar modules.
- Local assembly can shorten delivery and customize module/branding only if quality is proven.
- One bill of materials and power class simplify traceability.
- EL, lamination, electrical safety and calibrated flash testing are essential for warranty credibility.

### Sanaatchi delivery scope

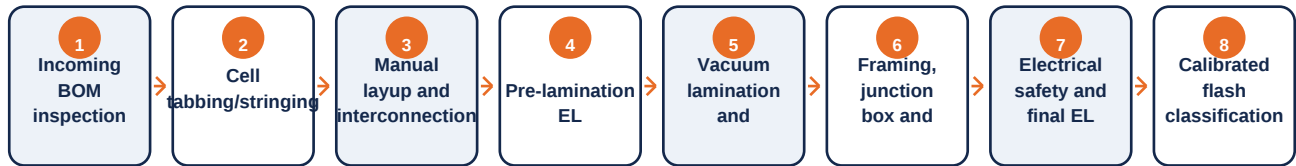
- Factory setup planning, supplier pre-qualification, and technical comparison
- Complete production-line and individual equipment supply
- Factory layout, utilities, civil-work coordination, installation, and commissioning
- Raw-material sourcing, trial-batch qualification, and repeat supply planning
- International logistics, customs documentation, operator training, spare parts, and after-sales support

### Recommended configuration

Launch one framed 144 half-cell module design at roughly 5-10 MW/year using imported matched cells and a semi-manual line. Include supported tabber-stringer, layup tables, two EL stations, vacuum laminator, framing/junction-box fixtures, curing, hipot/ground/bypass-diode tests and a calibrated AAA solar simulator. A soldering table without EL, lamination control and flash classification is not a bankable module factory.

## Manufacturing Process & Product Portfolio

### Integrated process flow



### Target products

| Product                              | Typical specification                                                                                                                      | Primary market                                    |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Framed crystalline-silicon PV module | Cell/BOM, dimensions, nominal power, efficiency, insulation, wet leakage, EL acceptance, flash tolerance, mechanical load and traceability | Afghan solar distributors and project integrators |

This is module assembly, not solar-cell manufacture. Supplier acceptance builds a statistically meaningful pilot lot and measures solder peel, string alignment, bubble/voids, gel content or lamination recipe, frame squareness, junction-box adhesion, insulation/hipot, grounding, bypass diodes, pre/post EL crack grading and calibrated flash power. IEC design qualification and factory surveillance require external accredited testing.

## Core Equipment Schedule

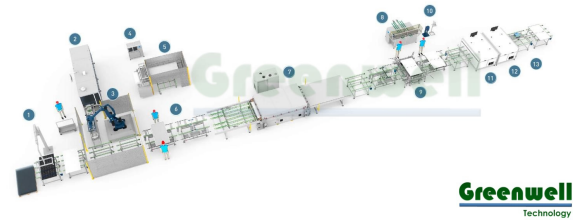
| Step | Equipment                              | Function                                 | Indicative parameter        |
|------|----------------------------------------|------------------------------------------|-----------------------------|
| 1    | Cell inspection and tabber-stringer    | Bins and interconnects cells             | One 144-half-cell design    |
| 2    | Layup tables and bussing tools         | Builds module circuit and sandwich       | ESD/traceability control    |
| 3    | Pre/post EL testers                    | Detects cracks and inactive areas        | Two quality gates           |
| 4    | Vacuum laminator                       | Encapsulates circuit                     | Recipe logged               |
| 5    | Framing/J-box and curing stations      | Completes mechanical/electrical assembly | Adhesive controlled         |
| 6    | Safety testers and AAA solar simulator | Releases safety and power class          | Calibrated reference module |

Equipment models are indicative and will be matched to the selected capacity, local raw-material tests, available utilities, and preferred automation level.

## Reference Equipment Gallery



*Made-in-China supplier reference: real manual solar-module assembly line equipment.*



*Made-in-China supplier reference: second real machine configuration for manual solar-module assembly line.*

Images are supplier references for configuration discussion; final equipment appearance and model may differ.

## Plant, Raw Materials & Utility Requirements

### Raw materials

- Matched mono crystalline cells by power/current bin
- Solar glass, EVA/POE encapsulant and qualified backsheet
- Tinned ribbon, busbar, flux and approved sealants
- Aluminium frames, junction boxes, cables, connectors and labels

### Utilities & infrastructure

- Stable three-phase electricity with verified connected load
- Guarded machinery, lockout, ventilation and fire protection
- Dry segregated raw-material and finished-goods storage
- Maintenance tools, safe lifting and critical spare parts
- Clean temperature/humidity-controlled layup and material rooms
- ESD controls, compressed air and calibrated electrical laboratory

### Quality, safety and environmental controls

- Trace every cell, glass and encapsulant lot
- Control solder temperature, peel and string alignment
- Grade EL before and after lamination
- Record vacuum, temperature and lamination recipe
- Test hipot, insulation, grounding and bypass diodes
- Flash-test with calibrated simulator and retain module history

A final factory layout must reserve safe forklift routes, maintenance clearances, raw-material segregation, finished-goods storage, fire protection, ventilation, and future expansion space.

## Indicative Investment & Implementation Plan

### LOW-ENTRY CONFIGURATION

The credible entry is semi-manual but retains both EL gates, a controlled laminator and calibrated flash/safety laboratory. Solar-cell manufacture and full automation are excluded.

| Component                               | Indicative range | Notes                                              |
|-----------------------------------------|------------------|----------------------------------------------------|
| Stringing, layup and EL equipment       | US\$95k-220k     | Semi-manual 5-10 MW/year                           |
| Laminator, framing and curing           | US\$85k-210k     | One module envelope                                |
| Safety/flash laboratory and calibration | US\$70k-180k     | AAA simulator basis                                |
| Freight, clean-room services and spares | US\$55k-140k     | Pilot-lot commissioning                            |
| Indicative installed project total      | US\$305k-750k    | Building, certification and BOM inventory excluded |

### Implementation sequence

|         |            |                                                                                                        |
|---------|------------|--------------------------------------------------------------------------------------------------------|
| Phase 1 | 2-5 weeks  | Confirm product specification, representative raw material, buyer, capacity, site and utilities        |
| Phase 2 | 3-7 weeks  | Run supplier trials with the buyer material and freeze the balanced machine, tooling and utility scope |
| Phase 3 | 8-22 weeks | Manufacture or refurbish, inspect, document and ship the contracted equipment                          |
| Phase 4 | 3-12 weeks | Install, commission, train operators and pass material-specific acceptance tests                       |

Ranges are planning targets for a low-cost entry configuration, exclude land, and remain subject to confirmed capacity, supplier quotation, freight, duties, exchange rates and site conditions.

## Next Steps & Contact Information

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### Recommended next steps

- Confirm target products, hourly output, and packaging formats
- Test representative raw materials and document quality requirements
- Complete site survey covering electricity, water, fuel, drainage, roads, and warehouse space
- Request comparable technical and commercial quotations from shortlisted suppliers
- Finalize financing, logistics, installation, training, and spare-parts plan

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### Research and image references

- <https://www.made-in-china.com/showroom/winnergy/product-detailDxmXgsrndVI/China-Winnergy-20MW-Solar-Panel-Production-Line-Solar-Module-Equipment-Plant.html>

- <https://www.made-in-china.com/showroom/greenwellsolar/product-detailRxHpyPAEVThZ/China-20MW-Solar-Panel-Production-Line-Turnkey-Solution.html>