



AO GEP 03/24

SPECIFICATIONS FOR

The acquisition, installation and commissioning of a

Glovebox/Coating System and characterization for

tandem solar cells fabrication

based on perovskites/HJT

Your speakers:

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CHAPTER I: CONDITIONS

ARTICLE 1: OBJECT

The purpose of this consultation is to define the technical specifications, to be fulfilled by the suppliers, for the acquisition, installation, and commissioning of a controlled-atmosphere glove box system with some specific equipment; for the fabrication and the characterization of tandem solar cells based on perovskites/HJT, at **the GREEN ENERGY PARK research laboratory** in Benguerir.

ARTICLE 2: REFERENCE DOCUMENTS

2.1 Law

The contract resulting from this tender will be subject to Moroccan law.

Any disagreement between Green Energy Park and the Provider shall be settled amicably by cooperation between the two parties; otherwise, litigation will be submitted to the competent court in Rabat unless specific clauses figure in the selling engagement of the supplier, in which case they shall prevail.

2.2 Contractual Documents

The obligation of the supplier for the performance of works that are the subject of this Tender will result in the whole constituent pieces of the engagement designated as bellow:

- *The contract concluded with its annexes and amendments
- *This Document
- *The orders
- *The submission and, where necessary annexes

After its notification, the engagement will be able to be modified only by amendments or letter exchanges accepted by both contracting sides.

ARTICLE 3: DEADLINE AND PLACE OF SUBMISSION OF TENDER

Tenders must be submitted according to conditions and delays planned by these specifications to the purchasing department by March 26th, 2024 before **12 PM GMT**.

The submission address is the following:

IRESEN : 16 Rue Amir Sidi Mohamed – Souissi – 10100 Rabat

Foreign suppliers must establish a price quotation according to the Incoterm DAP Benguerir, disaggregating the cost of transporting the equipment.



Local suppliers must be able to submit a proposal including the shipping. This latter is their responsibility to the delivery place: Benguerir.

As an institute, Green Energy Park benefits from the UNESCO exemption of customs duties. So, Moroccan companies can submit a proposal without customs duties.

ARTICLE 4: SUBMISSION FOLDER

Any tenderer is required to present a folder of submission containing:

4.1. ADMINISTRATIVE FILE:

This folder must contain:

- A declaration on honor ;
- Excerpt of K-BIS or the certificate of registration in the commercial register for persons subject to the obligation to register in accordance with the legislation in force;
- Company Status
- Certificate of being up to date with payment of taxes (less than 6 months)
- Certificate of being up to date with payment of social obligations (less than 6 months)
- The document or documents justifying the powers conferred on the person acting on behalf of the tenderer;
- These specifications initialed, signed and sealed

4.2. TECHNICAL OFFER

The supplier's technical offer must comply with, or exceed, the technical specifications as specified in article 6 "**CHARACTERISTICS AND TECHNICAL SPECIFICATIONS**".

The technical offer must also include the references of the tenderer.

4.3. FINANCIAL OFFER

The detailed price schedule must be clearly specified. The supplier can submit an offer for one or several lots.

Please note that each lot should be invoiced separately in the financial offer.

Please note that the optional features should be invoiced separately in the financial offer.

The offer presented by each tenderer is put in a signed and sealed envelope. This folder contains three (03) envelopes:

- The first envelope: the administrative file. This envelope must be sealed and show, in addition to the information on the envelope, the mention "Administrative file".
- The second envelope: contains the technical offer. This envelope must be sealed and bear, in addition to the indications on the envelope, the words "Technical Offer".
- The third envelope: contains the tenderer's financial offer. This envelope must be sealed and bear, in addition to the information on the envelope, the words "Financial Offer".

ARTICLE 5: PROCEDURE FOR AWARDING



This consultation will be sold following the needs of Green Energy Park. The supplier will be chosen based on the equipment's quality, the respect of the formulated needs in article 6 and the financial offer;

CHAPITRE II: SCOPE OF DELIVERY

ARTICLE 6: CHARACTERISTICS AND TECHNICAL SPECIFICATIONS

Lot 1: Glovebox system

The glove box is a hermetically sealed container intended for manipulating substances in a controlled atmosphere, using integrated gloves that permit the user to perform inside the glovebox without compromising containment. The glove box is used for hybrid perovskite solar cells deposition, which requires an inert and tightly enclosed atmosphere, to ensure both the quality of the thin films and the safety of the user.

The present glovebox will be split into two parts: wet and vacuum coating sections. The wet coating system will be dedicated to solvent based perovskite processing, and will contain slot die coater (lot 2), a microbalance, two hot plates and chemicals. The other section will involve a the thermal evaporator (lot 3) to deposit metallic contact and organic thin film (etl, Htl.), in addition to a solar simulator (lot 4). These two sections will be connected by a T chamber (see III.2.1.2 Connecting Antechamber). For this system, Modular box design is needed for easy extension.

Glovebox wet section

Design	single-sided glovebox
Dimensions workspace	Inside depth: 780 mm
	Inside height: 900 mm
	length: 1800 mm
Specifications	All-welded stainless-steel enclosure
	Castors for easy moving and fixed levelers to level and stabilize the glove-box
	Window Scratch resistant polycarbonate
	4 Glove ports, 220 mm diameter, O-ring sealed
	Gloves Butyl, thickness 0.4 mm
	Front panel with LED lighting (Light Fluorescent lamp)
	3 Adjustable shelves hanged on the back (Stainless Steel)
	High efficiency particulate air (HEPA) dust filters installed on purifier inlet and outlet
	4 Feedthroughs (Aluminium, single-sided) and 1 electrical (230V, 1 ph)
Working gas Nitrogen, Argon and Helium	



	Minichamber (Dia.100 (150) mm, length 300 (330) mm) (Type: 1/3 inside, 2/3 outside the box; Operation: manual, 3-way valve Incl. sliding tray).
Normes	Conform to CE (conformité européenne)
Special conditions and specifications	<ul style="list-style-type: none"> • Slot die coater Integration • Additional hole for gas tube integration is required. • Anti-vibration table is required to ensure weighing accuracy (A microbalance will be integrated inside the glovebox) • Modular enclosure
Gas Purification	H2O content, & O2 content < 1 ppm; Leakage rate < 0.05 Vol%/h
	PLC controller with color touch panel
	0-60 CFM continuously variable blower, with frequency controlled; vibration dampened, without heat load generation.
	Automatic pressure control w/ Foot Switch (± 15 mbar)
	Negative and/or positive pressure operation
	Oxygen, moisture sensors and purge function included
	Vacuum Pump: Rotary vane pump with 10 CFM equipped with oil mist filter, with gas ballast control; flow rate: 12 (17) m ³ / h.
	Simultaneous purification and regeneration
	Stainless Steel Piping
Purifier unit (auto purging system)	Closed loop recirculation
	Unit for inerting (purging) of the workspace with inert gas Operation: via operation panel of the gas purifier Valves PLC-controlled
	Flow rate: max. 200 l/min; incl. manual regulation valve for reduction of the gas flow
	Oxygen removal: (20- 36) l (standard conditions), Moisture removal: (1350-2600) g
Unit for removal of solvent contaminations	Purging ON / OFF
	A minimum of five (5) kg carbon reagent capacity
	The solvent removal system shall have an isolation valve, evacuation capabilities, and a vacuum gauge to allow for changing the solvent removal reagent without contaminating the glove box atmosphere.

Connecting Antechamber

Specifications	T Type Vacuum chamber made of stainless steel, with size close to 390 x 600 mm, and Leak Rate 10^{-5} mbar l/s
	Automatic evacuation/refill/ pressure controlled (if semi-Automatic evacuation/refill is available it is acceptable)
	Operated on Touch Panel



	Including sliding tray
	Auto control of cycles
	Intermediate vacuum for refill/ Ultimate vacuum

Vacuum coating glove Box

Design	single-sided glovebox
Dimensions work-space	Inside depth: 780 mm
	Inside height: 900 mm
	length: 1500 mm
Specifications	All-welded stainless-steel enclosure
	Castors for easy moving and fixed levelers to level and stabilize the glovebox
	Window Scratch resistant polycarbonate
	4 Glove ports, 220 mm diameter, O-ring sealed
	Gloves Butyl, thickness 0.4 mm
	Front panel with LED lighting (Light Fluorescent lamp)
	3 Adjustable shelves hanged on the back (Stainless Steel)
	High efficiency particulate air (HEPA) dust filters installed on purifier inlet and outlet
	4 Feedthroughs (Aluminium, single-sided) and 1 electrical (230V, 1 ph)
	Working gas Nitrogen, Argon and Helium
Normes	Conform to CE (conformité européenne)
Optional	Minichamber (Dia.100 (150) mm, length 300 (330) mm) (Type: 1/3 inside, 2/3 outside the box; Operation: manual, 3-way valve Incl. sliding tray).
Special conditions and specifications	<ul style="list-style-type: none"> • Thermal vacuum evaporator integration • One modular enclosure
Gas Purification	H2O content, & O2 content < 1 ppm; Leakage rate < 0.05 Vol%/h
	PLC controller with color touch panel
	0-60 CFM continuously variable blower, with frequency controlled; vibration dampened, without heat load generation.
	Automatic pressure control w/ Foot Switch (\pm 15mbar)
	Negative and/or positive pressure operation
	Oxygen, moisture sensors and purge function included
	Vacuum Pump: Rotary vane pump with 10 CFM equipped with oil mist filter, with gas ballast control; flow rate: 12 (17) m ³ / h.
	Simultaneous purification and regeneration
	Stainless Steel Piping
	Closed loop recirculation



Purifier unit (auto purging system)	Unit for inerting (purging) of the workspace with inert gas Operation: via operation panel of the gas purifier Valves PLC-controlled
	Flow rate: max. 200 l/min; incl. manual regulation valve for reduction of the gas flow
	Oxygen removal: (20- 36) l (standard conditions), Moisture removal: (1350-2600) g
	Purging ON / OFF

Lot 2 : Slot Die coater

A slot die coater is a machine which can deposit thin films via solution processing on substrates of various materials such as glass, metal and polymers, via narrow slot. This coating technique enables rapid deposition of uniform thin films with minimal waste and low operating costs. The appropriate coating material is commonly dissolved or suspended in a precursor solution or slurry (ink) and applied to the substrate surface using the precise coating head. To achieve this, the ink is dispensed at a controlled speed as the head moves relative to the substrate.

Deposition	<ul style="list-style-type: none"> • Perovskite thin films deposition • Organic thin films deposition
Design	<ul style="list-style-type: none"> • Glovebox integrated system
Slot Die Coating area	<ul style="list-style-type: none"> • Min 16 cm*16 cm
Maximum Hotplate Temperature	<ul style="list-style-type: none"> • 160°C
Head	<ul style="list-style-type: none"> • Adjustable level • Stainless Steel material • head heating up to 80 °C
Features	<ul style="list-style-type: none"> • The syringe pump is integrated into the coater. The slurry feeding is completely sealed. • The vacuum chuck and pump are also integrated into the coater • Direct film thickness control from nano to micrometers • The coater with a 24V DC motor is able to be used in the glovebox with Argon atmosphere • Hold a flexible substrate • Excellent layer definition, uniformity and reproducibility
Viscosity range	<ul style="list-style-type: none"> • 1 to 10000 cP
Coating Speed & Length	<ul style="list-style-type: none"> • Travel Speed: 0.05 - 50 mm/s adjustable via touch screen control panel



	<ul style="list-style-type: none"> Maximum Coating Area: 160 mm length x 160 mm width
Screen control panel	Included
Compliance	CE certified
Accessories	Set of shims to set the slot depths

Lot 3: Thermal evaporator

The thermal evaporator is an equipment that uses resistive heat source to evaporate a solid material in a vacuum environment to form a thin film. Thermal evaporation deposits both metals and non-metals. This equipment will be used for the deposition of organic thin films and metal contacts for perovskite solar cells.

Deposition	<ul style="list-style-type: none"> Metal contacts Organic thin films Inorganic thin films (metals and non-metals)
Design	<ul style="list-style-type: none"> Glovebox integrated system
Number of evaporation sources	<ul style="list-style-type: none"> 2 Low Temperature Evaporation Sources 2 high Temperature sources
Co-deposition	<ul style="list-style-type: none"> Included
Sequential deposition of thin films without breaking the vacuum	<ul style="list-style-type: none"> Included
Sample holder system:	<ul style="list-style-type: none"> Substrate holder up to 160 mm x 160 mm Movable covers for metal contact deposition Adjustable distance between sample holder and evaporation source Evaporation sources installed on the bottom of the vacuum chamber
Operating temperature	<ul style="list-style-type: none"> Organic sources: 80-600°C Inorganic sources: 200-1700°C
Organic power supplies and controllers	<ul style="list-style-type: none"> Organic sources separated (LTE) on inorganic sources (ET)
Thickness control system	<ul style="list-style-type: none"> Quartz crystal microbalance for thickness and deposition speed control Automatic /and manual control of power supply and deposition speed Quartz crystal sensor inside the chamber
Pression	<ul style="list-style-type: none"> $< 5 \times 10^{-7}$ mbar
Layer uniformity	<ul style="list-style-type: none"> $< +/- 5\%$
Sources of evaporation	<ul style="list-style-type: none"> Crucibles, filaments



Evaporation materials for metal contact	<ul style="list-style-type: none"> • Gold (Au), Silver (Ag) and Copper (Cu)
PC with control software	<ul style="list-style-type: none"> • Included
Accessories	<ul style="list-style-type: none"> • Basic substrate carrier/ Basic shadow mask/ basic back panel/ spacer layer/ and a designed shadow mask (designed following a discussed layout and compatible with the IV unit)

Lot 4: Solar Simulator and IV unit

A solar simulator is a device that emits light with a spectral composition and intensity similar to that of the sun. Typically, it is connected to the IV unit in order to measure and evaluate the devices. It is used in a wide range of research areas, for our purposes, we will use them (solar simulator and UV unit) to characterize perovskite solar cells in controlled conditions and standards.

Solar Simulator	LED-based light source
	Spectral match class A++ (AAA)
	Software for control of light engine.
	Glovebox integrated (might need an upgrade for Solar Simulators Test Windows at the bottom of the Glove Box)
	Recirculation chiller for continuous illumination and fast cycle times ensuring long cycle life of light source
	Long exposure time for high-efficiency solar cells
	Non-uniformity for intensity < 2% (uniformity class A).
	Minimum Test area: 10*10 mm up to 51x51mm,
	Intensity instability of less than 2%
	Line Regulation: 0.01 Percent
	The range of attenuation is from 0.75 - 1.25 SUN
	Spectral range from 360 nm up to 1,100 nm.
	Air Mass 1.5G Filter.
IEC 60904-9 certification	
IV unit	Computer (PC) and a software to measure the current-voltage curve of a solar cell and then automatically calculates key device properties.
	Parallel JV and stability measurements.
	The temperature of the samples can be controlled.
	Perform I-V measurements between -10 V and 10 V, with voltage step sizes as low as 333 μ V.
	Substrate Compatibility: Cell Holder Compatible with the evaporator mask.
	Airtight Chamber



	Measure low currents with an accuracy of ± 10 nA, or high currents up to ± 150 mA.
	Hysteresis I-V option
	Dark current measurement function
	Test data can be output as TXT file and/or .csv file

Lot 5: Quantum Efficiency Measurement System

The Quantum Efficiency Measurement system is used for solar cells characterization to evaluate their Quantum efficiency over different wavelengths and to measure the efficiency of the devices at each photon energy level. It indicates the amount of current that the solar cell will produce when irradiated by photons of a particular wavelength. And can also give strong information about stability and degradation over time.

Application	<ul style="list-style-type: none"> • Perovskite solar cells • Perovskite/silicon tandem solar cells
Measurement parameter	<ul style="list-style-type: none"> • QE (quantum efficiency) • EQE (external quantum efficiency) • IQE (internal quantum efficiency) • Transmittance • Reflectance
Wavelength range	• 300-1800 nm
Wavelength Accuracy	+/- 0.5 nm
Detector type	Si/Ge
repeatability	• >99.5%
Resolution	• 0.1 Hz (for 4-100 Hz chopper frequency)
Monochromator	• Included
Sample size	• From 1*1 cm ² up to 16*16 cm ²
lock-in amplifiers	• Dual phase: monitoring the optical power and measuring the device signal simultaneously
Signal acquisition	• Chopper with virtual lock in amplifier
Chopper Frequency	• 4.0 Hz - 100.0 Hz
Current Range	• 10 nA - 1.0 A
Voltage bias	• -10 to +10 V
Voltage Range	• ± 10 V (measurement)
Compatible with standards	• IEC 60904, IEC 17025, ASTM E1021
PC with control software	• Included
Accessories	<ul style="list-style-type: none"> • Light Tight Enclosure • Electrical contact probe • Temperature Controlled Vacuum Chuck



	<ul style="list-style-type: none"> • light source with adjustable intensity levels and the ability to install up to three colored filters
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Lot 6: Mechanical scriber

This equipment is used to scribe the interconnection in the solar cell’s architecture, enabling P1, P2 and P3 scribes which are used to electrically separate the electrodes of adjacent cells. It patterns the substrate into long and narrow stripes usually about 10 to 100 μm width. The mechanical scribing method requires clean and selective scribes through multiple layers.

Application	<ul style="list-style-type: none"> • P1, P2 and P3 pattern interconnection for tandem solar cells perovskite/HJT solar module fabrication
Features	<ul style="list-style-type: none"> • Mechanical patterning of P1, P2 and P3 is accomplished using a pressure sensitive setup. • The setup consists of a remotely controlled, micrometer precision XYZ stage with a spring mounted steel blade which can be compressed with a specific mechanical constraint. • Scribe should not damage the frontside of the sample • The height and angle adjustable
Width range	<ul style="list-style-type: none"> • 10 μm to 100 μm
Repeatability	<ul style="list-style-type: none"> • >99.5%
Sample size	<ul style="list-style-type: none"> • From rom 1*1 cm2 up to 16*16 cm²
Certificate	<ul style="list-style-type: none"> • Included

Lot 7: Optical microscope

The optical microscope uses visible light and optical lenses to magnify images of small objects. In our case we will use this equipment to see with accuracy the P1, P2, and P3 pattern made by the mechanical scriber (lot 6).

Application	<ul style="list-style-type: none"> • See with accuracy from 10 μm to 300 μm
Sample size	<ul style="list-style-type: none"> • From rom 1*1 cm2 up to 16*16 cm²
Screen control panel	<ul style="list-style-type: none"> • Included
Autofocus	<ul style="list-style-type: none"> • Included
Certificate	<ul style="list-style-type: none"> • Included

All the requirements mentioned before are necessary, nevertheless, the provider should absolutely include any other necessary aspects for an efficient installation and operation under the European standards even though they are not mentioned or specified in this document.



ARTICLE 7: WARRANTY PERIOD

The equipment and all accessories are warranted on Green Energy Park facilities for **two years** starting from the end of installation, including spare parts and labor;

Spare parts:

The system should be delivered with spare parts deemed necessary for use of at least 1 year.

ARTICLE 8: MAINTENANCE

The offer must contain 3 years maintenance contract after the warranty period, containing:

- Annual Preventive Maintenance Visit
- Spare parts
- Telephonic support and advice
- Annual software update
- Travel

All services and parts mentioned above will have to be delivered in Green Energy Park facilities (transport and accommodation costs on the supplier's charges).

During the warranty period and maintenance engagement, the whole fees will be charged on the supplier or its representative and include supply of spare parts, labor and transportation fees, accommodation and living expenses.

ARTICLE 9: INSTALLATION AND COMMISSIONING

All the elements required for the installation of the equipment and for its commissioning must be provided by the supplier. Installation, commissioning, good performance and training must be carried out within the deadlines mentioned in article 12 of these specifications, with the consequences mentioned in case of non-respect of deadlines.

ARTICLE 10: TRAINING

The training must be provided by the installation engineer in Green Energy Park offices in Benguerir on the supplier's charges.

ARTICLE 11: TECHNICAL DOCUMENTATION

The supplier commits to provide, upon delivery, all the necessary documentation for the use, repair and all the technical documentation of the system including the usage software in English, and if available, in French as well as all calibration certificates for all the components of the apparatus.

ARTICLE 12: TERMS AND EXECUTION CONDITIONS

The equipment must be delivered within a maximum period of 15 weeks from receipt of the purchase order.

If the delivery delay is other than 15 weeks, it must be specified on the offer.

ARTICLE 13: LATE PENALTIES



In case of exceeding the execution time specified in article 12, the supplier is liable to a penalty of 1‰ of the contract amount per day of late, with a maximum cumulative flat rate of 10% of the engagement amount, beyond which are applied dispositions of article 17.

ARTICLE 14: RECEPTION – VERIFICATION

a) Verification

The verification of the equipment subject of this order will take place in Green Energy Park facilities; they will be performed under the supervision of the project leader.

No delivery even if partial is accepted if the whole equipment does not respect the order form.

b) Reception

The reception and installation of the device with all its components must be done within a period not exceeding one month (30 days).

The final acceptance will be pronounced with Green Energy Park satisfaction according to the following points:

- Installation of the main equipment and its accessories
- Verification of the conformity of the whole equipment with the purchase order
- Training of Green Energy Park team staff

ARTICLE 15: PAYMENT CONDITIONS

The payment will be made on 30 days end of month after receiving the invoice and the final acceptance receipt.

The Supplier must produce a commercial numbered invoice established in 03 copies signed, dated on letters written. It must indicate the references of the contract of the related order.

These invoices must be addressed to Green Energy Park's Accounting department, located at :
IRESEN

16, Rue Amir Sidi Mohamed – Souissi – 10100 Rabat

ARTICLE 16: HOLDBACK

A 10% holdback is provided upon the purchase of equipment that will be released after the warranty period

ARTICLE 17: CONTRACT CANCELATION

Regardless of expected cases of common Law, the Contract resulting from these specifications may be terminated with plain rights by Green Energy Park, with Recipient faults, and after formal notice by registered letter within a period of 20 days in the following cases:

- ▶ Fraudulent acts relating to the nature, the quality and reliability of the equipment and services covered by these specifications
- ▶ In case of exceeding the maximum flat rate of late penalties as indicated in article 13.

ARTICLE 18: RISKS INSURANCE

The supplier declares to be covered by a professional civil insurance against the risks that he incurs during his activity and throughout the duration of the execution of this contract. This



insurance must cover all risks that encounter his staff at Green Energy Park. The Client reserves the right to request copies of the insurance policy or certificate of cover.