

## Annex 01

### Questions for:

#### Market consultation R2R perovskite Pilot Line

Reference: WS2731057802

#### Preface R2R perovskite Pilot Line

TNO aims to realise an R&D Pilot Line to demonstrate the technical feasibility of roll-to-roll (R2R) perovskite solar production. While there is equipment, such as a roll-to-roll slot die coater, already available in-house, additional equipment required to shape and operate the Pilot Line will need to be acquired. Where TNO has defined the process requirements, we will need the expertise and input of an external party for the mechanical engineering as well as the connecting software of the entire line. This partner will help us determine the final technical specifications, purchase the necessary machines and software and will be responsible to implement a correctly functioning working Pilot Line over a foreseen time period of approximately a year.

Total overview of the R2R Pilot line to develop includes below list of components, whereby noted that in many cases only specific parts of the mentioned machines will be used in the Pilot line:

- a R2R slot die machine (available in-house)
- a R2R sputter machine
- a R2R spatial atomic layer deposition machine (sALD)
- a R2R laser machine
- a Tool to apply electrical contacts to the process devices
- a R2R automated characterisation set-up
- a R2R slitting/cutting set-up
- a Data management system

The above listed components will require (part) acquisition, development and/or engineering:

Component:	Needs:
a R2R slot die machine (available in-house)	To be adapted/engineered
a R2R sputter machine	(Part) acquisition and developed to fit in the line
a R2R spatial atomic layer deposition machine (sALD)	(Part) acquisition and developed to fit in the line
a R2R laser machine	To be engineered and built to new specification
a Tool to apply electrical contacts to the process devices	(Part) acquisition and developed to fit in the line
a R2R automated characterisation set-up	To be engineered and built to new specification
a R2R slitting/cutting set-up	To be engineered and built to new specification
a Data management system	Acquisition and core customisation/development to integrate all relevant components

Ideally, TNO envisages the ability, throughout the course of the project, to develop the process steps on both the individual machines as well as on the integrated Pilot Line.

In the collaboration, the partner will be responsible for the functioning of the complete Pilot Line, where TNO will be responsible for the process development. Together, we will be responsible for the goal of the tool:

- Creating state of the art perovskite modules via scalable techniques
- Applying smart industry concepts to accelerate perovskite cells and modules optimisation

## Market consultation

Before preparing for a tender, TNO wants to consult the market on how such a tender can be structured (in broad terms). Within the framework of this Market consultation, specific advice is requested on how the potential market can meet our below mentioned topics and/or requirements.

The Market consultation is open to all market participants and benefits all parties involved. TNO investigates the possibilities and market perceptions. With the answers and comments to below questions, interested market participants gain insight into, and a good understanding of the contract in an early stage. Furthermore, the answers parties provide during the Market consultation can influence the requirements that will be included in the tender. In this way, participants can contribute to the tender's success.

TNO is interested to find partners to be part of this challenge and wants to find out whether relevant qualifications are available to complete this R2R Pilot Line in a successful manner. To that note we have formulated these relevant Qualifications together with Questions.

The purpose of the Market consultation carries the following aspects:

- To gain insight to what extent the market can meet the below specifications/requests
- To gain insight into the current possibilities and choices in the market
- To gain insight into the visions, ideas and suggestions of the market
- To gauge interest in this potential tender
- To determine which purchasing strategy best suits our functional requirements in the current market

NOTE: The results of the Market consultation can be included anonymously in the possible tender documents.

### 1. Technical feasibility and innovation

- a. Does your organisation have experience in developing or supplying R2R (roll-to-roll) equipment for flexible perovskite solar cells? Which ones? Please elaborate.
- b. Can you provide examples of similar projects or prototypes you have completed?
- c. What technical challenges do you foresee in integrating existing and newly developed components into a single working Pilot Line? Have you addressed these in the past, in terms of time, money, etc.
- d. What innovations in perovskite crystallisation, contact layers, or laser scribing can you offer?

### 2. Specifications and customisation

- a. To what extent can you adapt equipment to specific requirements, such as a process speed of 1–10 m/min, and temperatures below 150°C (see also question 6)?
- b. What possibilities do you see for inline characterisation and data integration within the Pilot Line? And what options have you applied in similar setups in the past?
- c. How do you handle the integration of a data management system for real-time monitoring and analysis?

### 3. Delivery, planning, and collaboration

- a. What is your view on planning the purchase or production of the Pilot Line components working towards completion of the full Pilot Line, i.e. differences in lead time for design, construction and release of the various machines?
- b. What flexibility do you have in planning, given the phased purchase and integration of the different components?
- c. How do you view collaboration with TNO and other partners in the ecosystem, for example in determining the final technical specifications?

**4. Costs and pricing structure**

- a. Can you provide a price indication for the various components (such as R2R slot-die upgrade, sputter machine, sALD, laser, characterisation, slitting/binning, data management)?
- b. Based on your experience, which factors will most influence the pricing (customisation, integration, development risks)?

**5. Maintenance, service and support**

- a. What service and maintenance options would you offer after delivery of the equipment?
- b. What is your view on support, troubleshooting and/or implementing upgrades?
- c. Do you have a service location in the Benelux?

**6. Sustainability and future-proofing**

- a. What is your vision on reducing CO2 footprint in the processes in your company?
- b. How does your solution contribute to the sustainability of the Pilot Line and scalability to industrial production?
- c. What possibilities do you see for future upgrades or expansions of the line?

To record your answers and/or comments, please fill Annex 02