150 HVolt-PV
High voltage IBC photovoltaic i-Cells and modules

Project duration: from 06.2016 to 05.2018
Report submitted: 07.2019

Publishable Summary

The actual photovoltaic module efficiencies in the market are around 16-17 % with price of about 50 c€/W. The modules efficiencies higher than 17% stay relatively small part of the total market. For efficiencies higher than 17% the module selling price increases significantly at a rate of about 10 c€/W for each additional absolute point efficiency.

The aim of this project is to develop a high efficiency n-type monocrystalline silicon IBC i-Cell module (efficiency > 21%) at lower cost. The following aspects will be investigated by means of industrial production tools:

1) **Reduction of the quantity of pure monocrystalline n-type silicon**: it has been demonstrated that monocrystalline foils of 40 µm thickness can give cell efficiency higher than 20%. However, present industry uses thickness of 180-200 µm. In this project, solar cells and modules will be made with wafers of 160 µm, 100 µm and 60 µm thickness using a fully standard wire sawing as a mean for silicon wafer slicing

2) **Reduction of Cell to Module losses using the high voltage low current i-Cell configuration**: so far around 3 % of absolute efficiency is lost after stringing and encapsulating photovoltaic cells into a module. The i-Cell concept will be used in this project to reduce these Cell to Module losses. This concept consists in realising quarter monocrystalline sub-cells (39x156 mm^2) connected in series by the mean of a low cost substrate that serves as mechanical support and electrical connection. This allows for a Voc increase by a factor of 4 **(from which the acronym HVolt-PV is derived)**, **electrical current reduction by a factor of 4**, and therefore **resistive losses reduction by a factor of 16**. The only resistive losses reduction into the ribbon will be responsible for reducing Cell To Module losses by **0,7% absolute efficiency**. Unused area into the module will be reduced using i-Cell interconnections and full square wafers. Targeted Cell To Module losses are **1,5% instead of 3%. The decrease of cell current will also allow for silver consumption reduction**

3) **Use of a low cost Interdigitated Back Contacts (IBC) cell technology**: screen-printing processes will be used for IBC cell for cost reduction purposes. This project proposes to make an optimisation of this process based on thin silicon foils wafers and i-Cell configuration

Under the previous considerations, 8 standard-size x60 IBC i-Cells (156x156 mm^2) photovoltaic modules will be produced and tested under real outdoor operating conditions and indoor standard test conditions to validate each kind of module prototype. The study will be conducted iteratively, starting by a full module validation using 160 µm **thick IBC cells, and pursuing the thickness reduction down to 100 µm and finally 60 µm.**

In this project **ISC Konstanz,** a top level German research institute in the field of photovoltaic will

be the partner in charge of IBC cell steps. **S'Tile**, a French spin off from the CNRS, will be in charge of cell cutting into quarter, assembly in series on its patented sintered substrate and module integration. The **University of Cyprus** that has outstanding outdoor facilities coupled with very favourable climatic conditions will be in charge of the outdoor evaluation of the modules. A certified European subcontractor will be asked to realise module certifications according to the indoor norms.

Project consortium

Coordinator and contact details:

Full name of organisation:	S'Tile SA
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Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
France	1	353'062	208'403
Germany	1	146'221	116'977
Cyprus	1	99'996	99'996
Total	*3*	599'279	*425'376*

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
Agence de l'environnement et de la maîtrise de l'énergie (ADEME)	N° 1605C0017 Ref : SRER-16-026 /RC/YD/GM
Bundesministerium für Wirtschaft und Energie	0324090 (Förderkennzeichen)
Research Promotion Foundation	KOINA/SOLAR-ERA.NET/1214/09