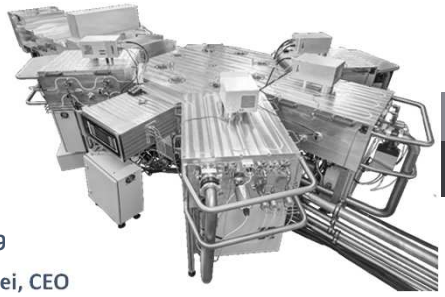
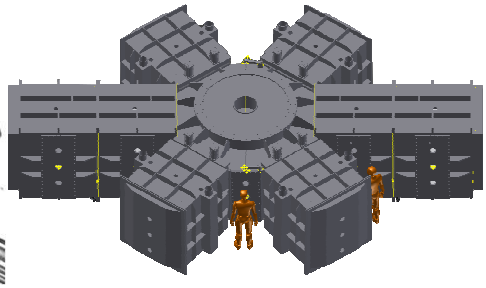
SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT

Déposition de couches minces par plasma "Miroir" pour la fabrication intelligente de cellules solaires à hauts rendements.





February –2019
Dr. Omid Shojaei, CEO

Company overview

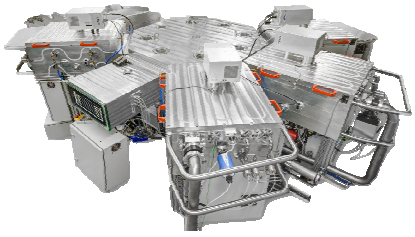
SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT

Facility facts

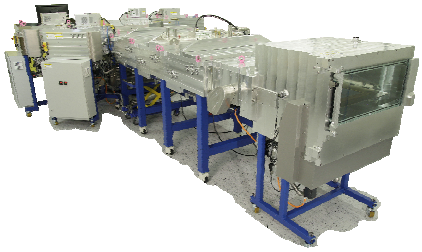
- 15 employees
- 360 m² clean room and service bay facilities with 3-stage filtration, humidity and temperature controlled
- Gas infrastructure with 16 process gas lines including gas detection
- Metrology equipment for material and device characterization (Raman, FTIR, I-V, EQE)
- System assembling hall and mechanical workshop
- System test facility for process and tool testing

Present Technology: Octopus plateform

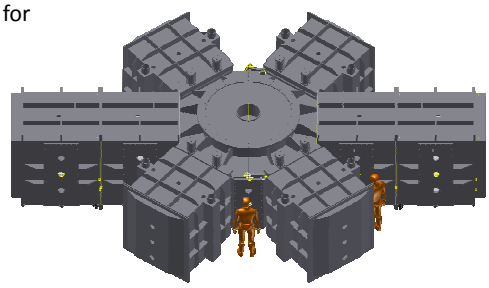
SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT



Pure PECVD configuration for small production



PECVD and PVD for complete SHJ deposition cycle



Octopus II: Extraordinary flexibility

SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT

Cluster

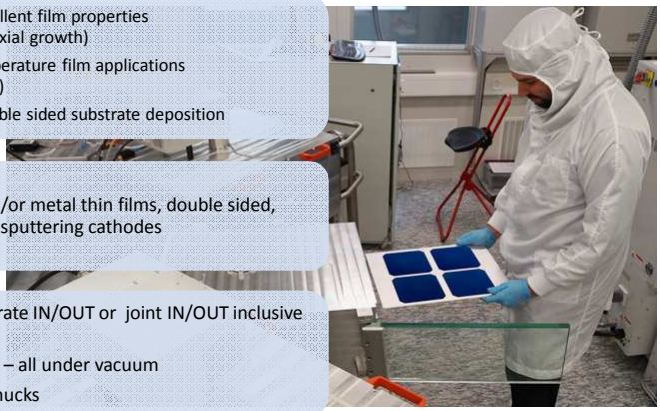
- **CLASSIC** – for excellent film properties (amorphous, epitaxial growth)
- **HT** – for high temperature film applications (passivation layers)
- **MIRROR** – for double sided substrate deposition

Inline

- **PVD**– for TCO and/or metal thin films, double sided, planar and rotary sputtering cathodes

Handling

- Load locks – separate IN/OUT or joint IN/OUT inclusive heating
- Chamber Transfer – all under vacuum
- Exchange – e.g. chucks



✓ For research and pilot production

Various Applications: PV, MEMS, OLED .....

SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT

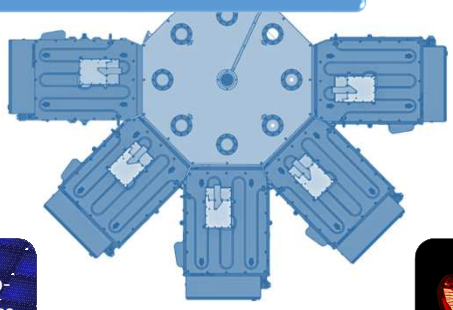


Photo-voltaics

INDEOtec's **proprietary Mirror reactor technology** makes **OCTOPUS III** the tool with the highest cell production capacity and the best price-performance ratio in the PECVD tool market.

MEMS Semi

The **Mirror reactor technology** can increase the throughput 3-4 times for roughly the same price as current available tools.

LED OLED

The **Mirror reactor technology** and **new deposition techniques** improve the quality of encapsulation and TCO layers. Both is instrumental for OLED lighting applications.

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References & Collaboration partners

SWISS MADE INDEOtec PLASMA PROCESS EQUIPMENT

csem

ASU Knowledge Enterprise Development

EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

جامعة الملك عبدالله للعلوم والتقنية
King Abdullah University of Science and Technology

IPVF INSTITUT PHOTOVOLTAÏQUE D'ILE-DE-FRANCE

Fraunhofer ISE

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HJT landscape producers & suppliers

SHJ producers	Ramping-up	Piloting	Equipment suppliers
CIE	Ecosolifier	CEA-INES	Applied Materials[1,2]
Hanergy	Enel/3sun	Kaneka	Ideal Energy[1]
Hevel	GS Solar	Meyer Burger	Indeotec[1]
Panasonic	Jinergy		Jusung[1]
Solar City	Neo Solar Power		Meyer Burger[1,2,3]
Sunpreme	Tongwei		Ulvac[1,2]
			Von Ardenne[2]
			Singulus[4,2]

The PV Market

TOP DOWN

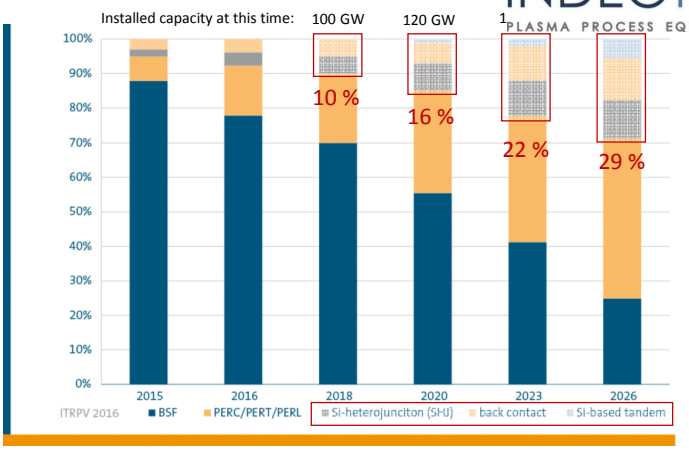
The graph shows the addressable market share for OCTOPUS III.

From 2018 .. 2023 the **additional capacity** to be installed is around **36 GW** in total.

INDEOTEC market research confirms 21 GW of capacity demand by 2021.

The Chinese company CIE expects 50% of the current cell capacity to be replaced by HJT in 6 .. 10 years.

BOTTOM UP



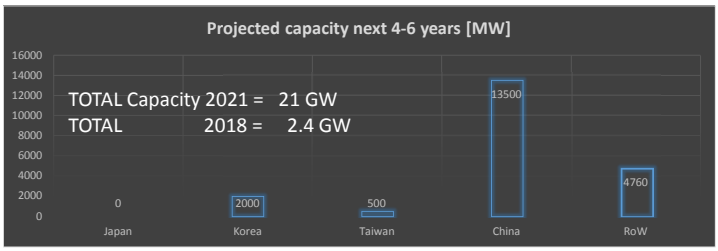
Worldwide market share for different cell technologies

Applicable market for OCTOPUS III

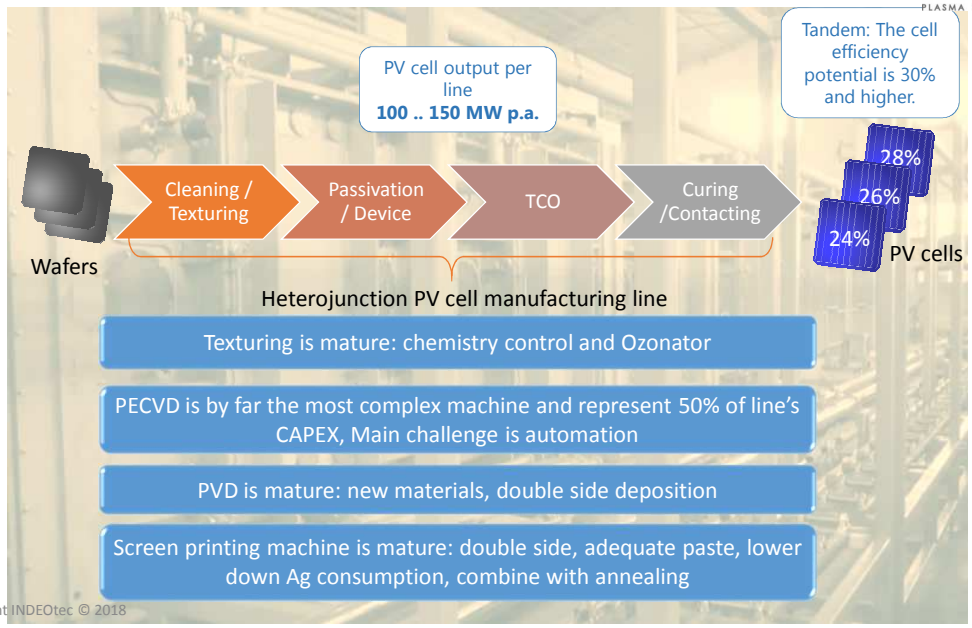
The total addressable market for OCTOPUS III until 2023 is **1'600 Mio US $.**

HJT Market outlook

Bottom-Up data collected by Indeotec



- HJT market:
  - Many assessment / investment ongoing (bottom-up 23GW within 5 years)
  - Pilot line (100MW) with reference tools to proof the efficiency, manufacturability, yield, module aasembly, field data, market acceptance…
  - If successfull then will increase capacity (bottom up data), timing uncertain!
  - CAPEX expected to be in range of 12m $ for complete cell line per 100 MW by 2020!
  - Minimum 23-23.5% avge efficiency at factory level for big investment to flow in!



Mirror PECVD

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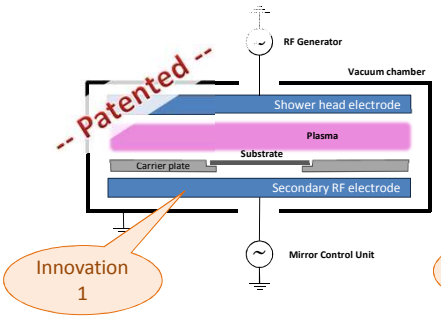
OCTOPUS - Mirror-PECVD

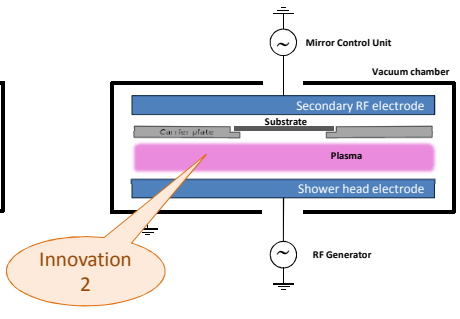
Mirror concept introduction

i/p – layers in top side reactor

i/n – layers in bottom side reactor



.. Additional electrode (3rd electrode) for enhanced plasma tuning



.. **Carrier on top** and **plasma from bottom** for bottom-side deposition

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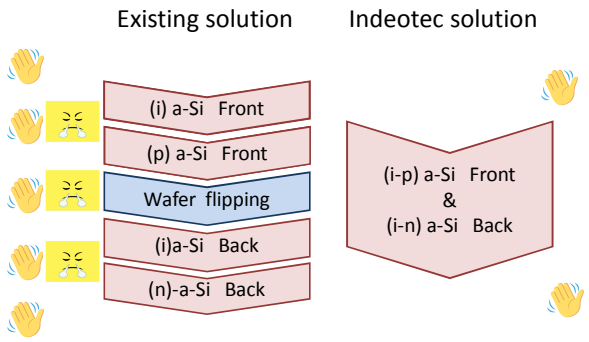
PECVD Mirror value proposition: simplification



- ✓ intrinsic and doped in same reactor
- ✓ NO flipping
- ✓ NO external handling
- ✓ NO in-between vacuum break

Wafer manipulation Vent/vacuum sequence

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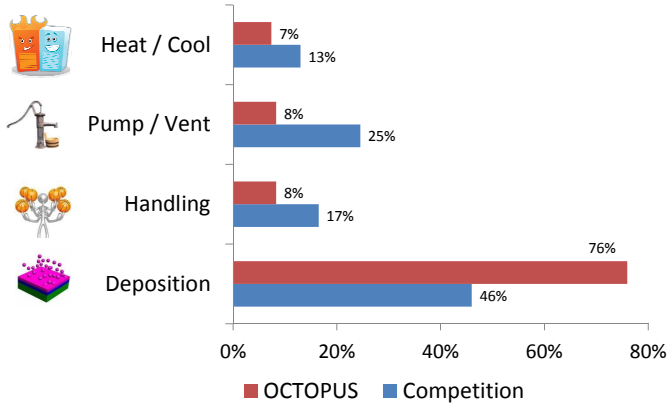
Wafer Residence time – Process step breakdown



Design target

Minimize every step, which does not add value !

Tremendous OPEX savings compared to other manufacturers. (> 30%)

Data baseline: PECVD process only, deposition time identical

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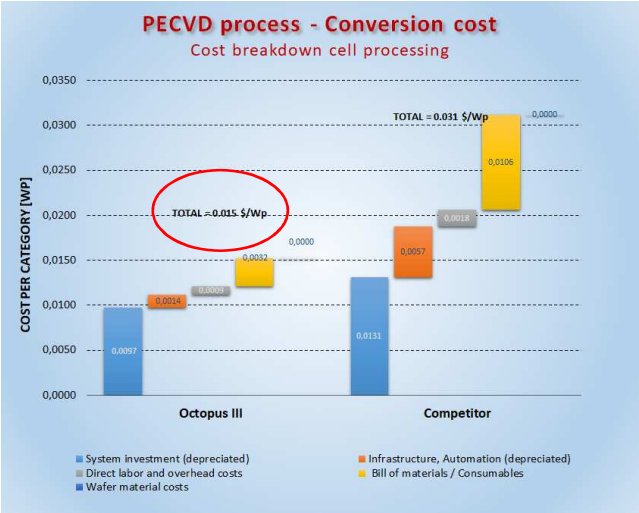
OCTOPUS III – COO

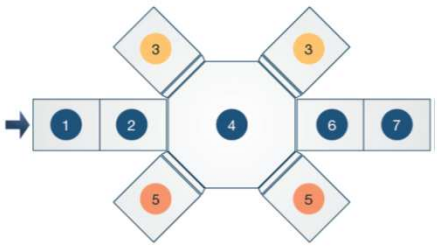
Comparison to Competition



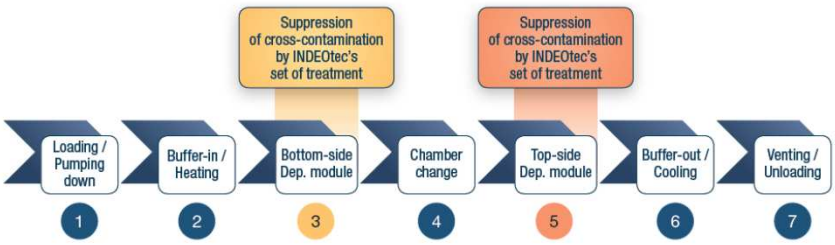
- **OCTOPUS III allows drastic cost reduction thanks to the comibination of Mirror, ACCT and Parallel Processing**
- **There is a saving potential of 1.5 cents /Wp**
- **At the scale of 1GW factory, the saving is > 15 Moi CHF per year**

Octopus III: Top & Bottom configuration

USP	HOW
Bi-facial coating	• Mirror Reactor patent • No cross contamination
Lean Manufacturing Enabler	• Simplified parts management • Easy tracing & Yield improvement
High Quality	• Uniform surface processing • Low defect level • Process Robustness
Fast Return on Investment	• High productivity • Low cost of ownership



- 3000 w.p.h.
- 140 MW p.a.



Technology Background: Oerlikon

Gen 5 - Kai 1200 PECVD for FPD & TF-Si

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Conclusions

- Mirror reactor concept works as well as the standard reactor in term technology transfer.
- Efficiency of >23% large area cell is achieved.
- Octopus III, with Mirror technology + ACCT + Parallel processing will deliver **>140 MW** TP p.a.
- Octopus III will be tested soon in Asia under production environment.

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