



# COMMERCIALISATION OF PEROVSKITE SOLAR CELLS

Richard Caldwell, Managing Director of Greatcell Solar (ASX: GSL)  
Investor Conference, Sydney April 2018

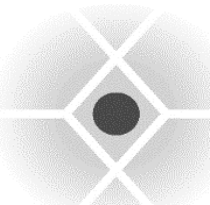


**greatcellsolar**  
Global leaders in hi-tech solar

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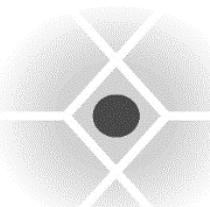
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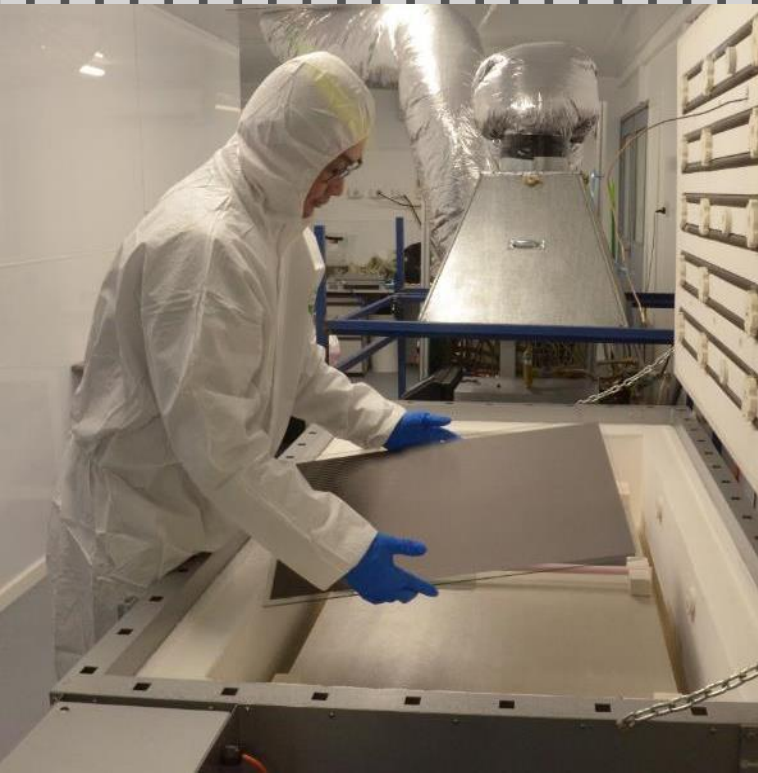
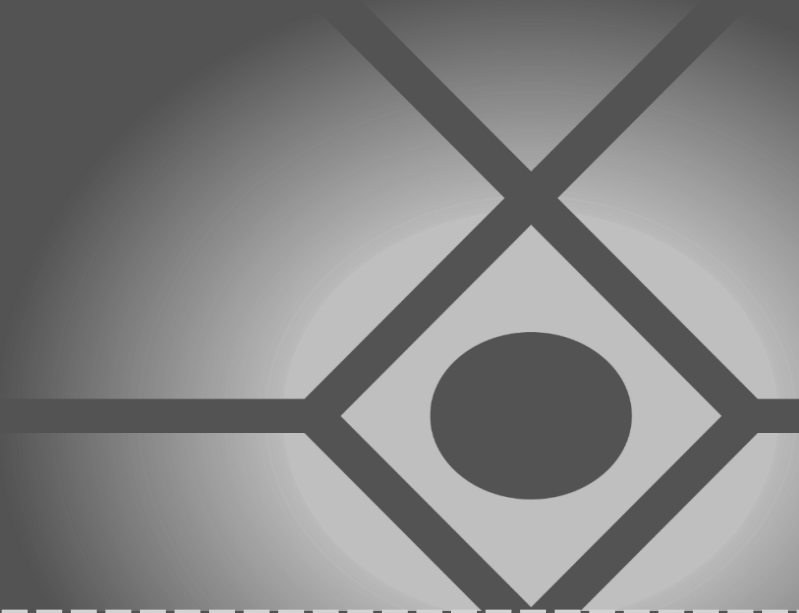


# AGENDA

- 1 The Business
- 2 Our Technology and its Benefits
- 3 Commercialisation
- 4 Major Area Demonstration Prototype Facility



# THE BUSINESS

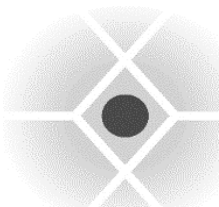


# THE BUSINESS

The Global Leader in the Development & Commercialisation of Perovskite Solar Cells (PSC) technology



- Upscale & commercialisation our 3<sup>rd</sup> generation PSC PV technology with the assistance of in-country government financial support and suitable local manufacturers and distributors in joint venture.
- We are a disruptive technology enablement company with a multi-generation Technology Development Plan to bring successive generations of improved technology to the global PSC PV market.
- Currently engaged in prototyping with plans to pilot line following successful completion of prototyping.
- Current commercialisation discussions are in Australia, Europe, UK, Turkey and China.
- We have an independent Stratagem Freedom To Operate study that demonstrates global IP superiority.

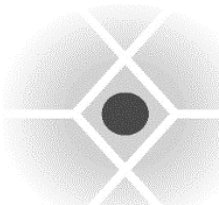


# THE BUSINESS

**A Global Manufacturer of High Performance Materials** (*dye solar cell, perovskite solar cell , specialty chemicals & equipment*):



- Greatcell Solar supplies to over 600 research based customers in over 60 countries, including Fraunhofer, Oxford University, CSIRO, Princeton, Wuhan University, KAUST, KIST, LG Electronics & Sungkyunkwan University.
- Greatcell Solar has the largest market share for the global supply of related specialty chemicals, including perovskites, mesoporous titania, inorganic hole transport materials & stabilising additives.
- Greatcell Solar also supplies equipment and laboratory solutions, including LED solar simulators.
- Greatcell Solar has excess capacity to scale materials production to commercial quantities for mass manufacture.



# THE BUSINESS

## GSL Business Model

Greatcell Solar partners with leading multinational manufacturers that possess strong brands and established routes to market that are seeking to embed PSC technology into their products to diversify their product offering.

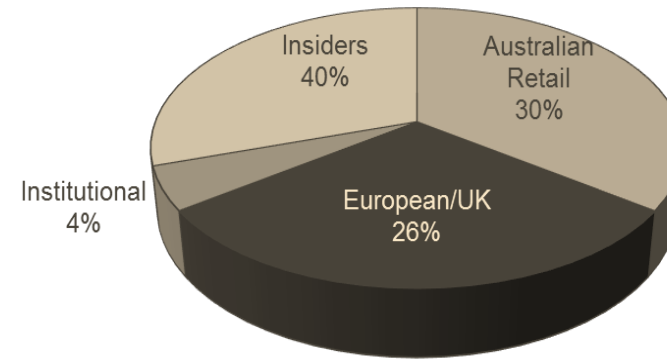
Greatcell Solar Partnership Experience:



&

## Capital structure

> 7000 Shareholders

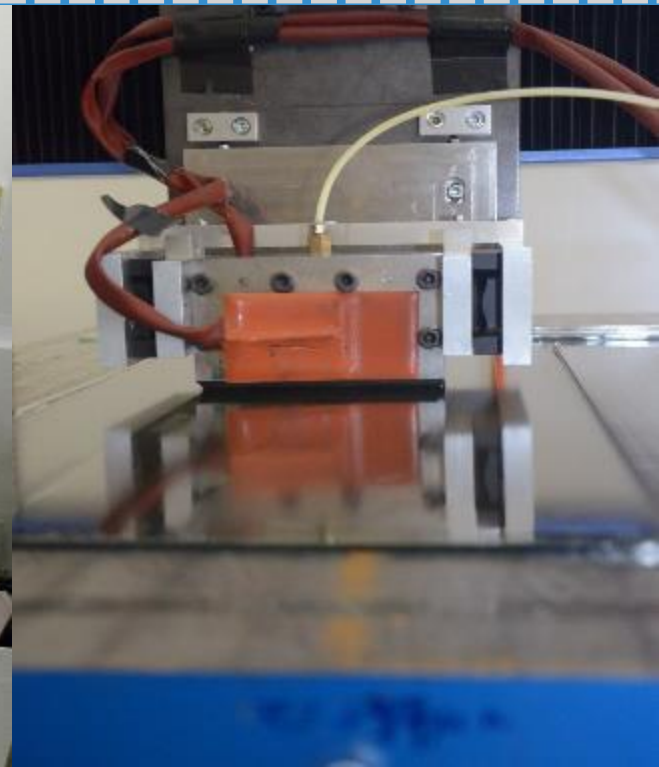
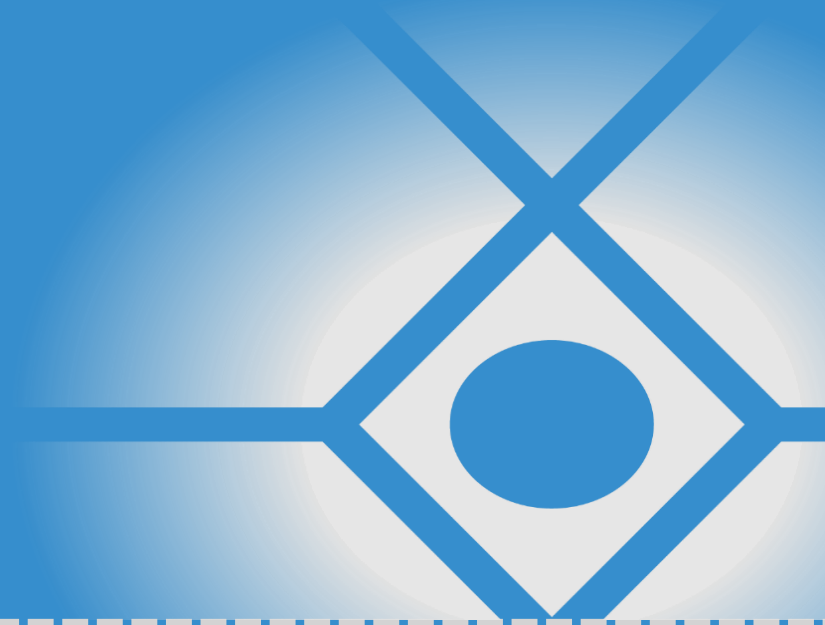


### Equity Snapshot

Ticker ASX	GSL
52 Week range	A\$0.165 to A\$0.225
Shares outstanding (fully diluted)	402M
Market Capitalisation @ A\$0.17	A\$68.4 million
Frankfurt Ticker	D5I
52 Week Range EURO	0.11 -0.18



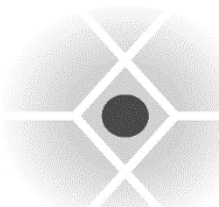
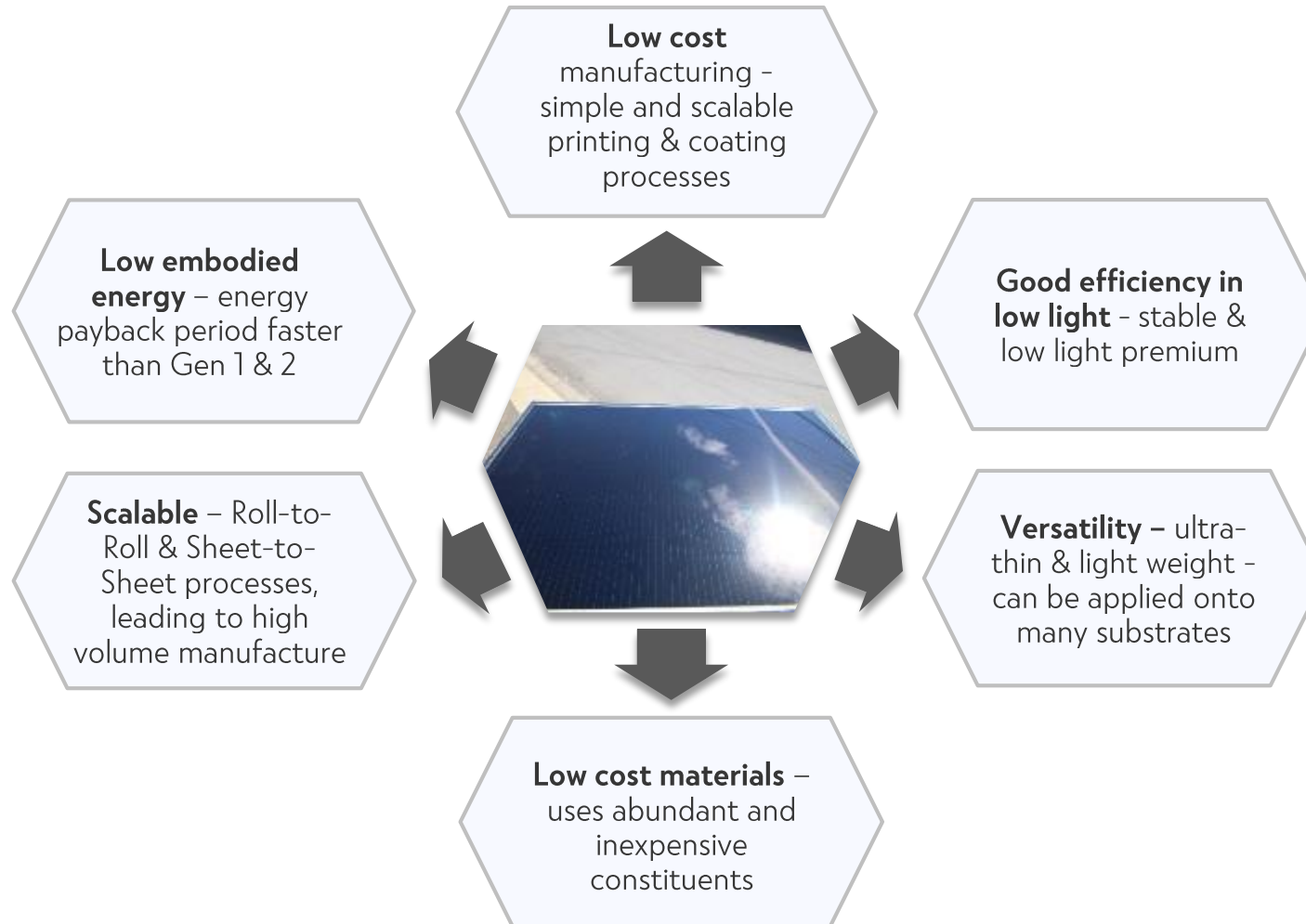
# OUR TECHNOLOGY & ITS BENEFITS





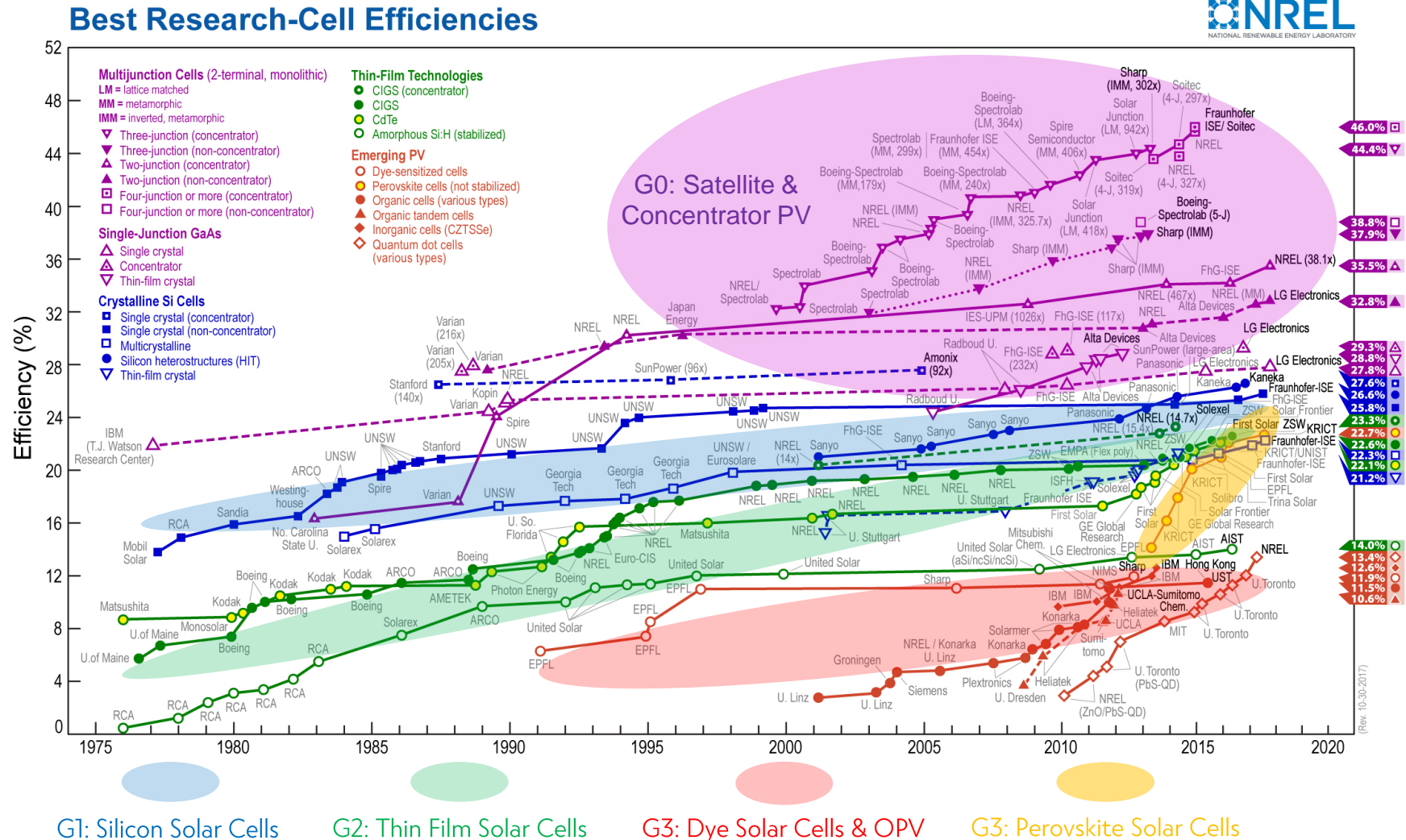
# OUR TECHNOLOGY & ITS BENEFITS

PSC belongs to the 3<sup>rd</sup> generation, 'ultra-thin' PV which includes multiple technologies that seek to improve upon the first two generations through a combination of cost reduction, increased energy efficiency and stability, improved aesthetics, and opportunity for product integration. Its heritage is in DSC and OPV.



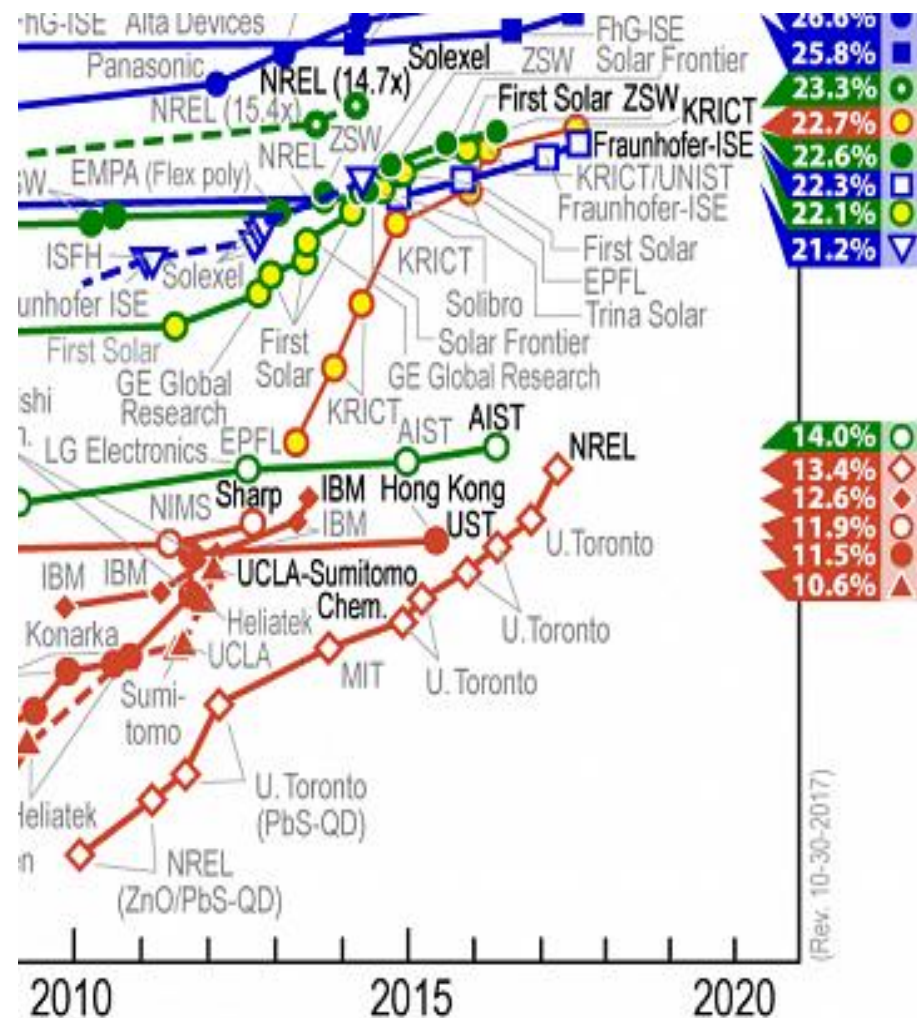
# SOLAR CELL GENERATIONS

## NREL Efficiency Chart



# OUR TECHNOLOGY & ITS BENEFITS

## Proven performance



- ✓ EPFL & KRICT are the lead R&D institutes pushing laboratory efficiencies from 12% to 23% in 5 years. However, these are not stabilized.
- ✓ Academics have projected that laboratory "hero cell" efficiencies may rise as high as 33%.
- ✓ Greatcell Solar focuses on producing cheap and durable panels with low-cost materials and addressing all relevant tests under IEC 61646/61215 in larger devices.
- ✓ There are 2 lead candidates for commercialisation, Porous Carbon and P-I-N which focus on an inorganic material sets delivering high stability and durability for glass and steel substrates, respectively.
- ✓ 12% - 15% industrial efficiencies are projecting LCOEs < A\$0.05

# OUR TECHNOLOGY & ITS BENEFITS

## In the Press



Greatcell Solar ranked 21<sup>st</sup> over 1000 (6<sup>th</sup> in 2016) Australian companies in Australian Financial Review Innovation Award in 2017 (we were the only renewable energy company in the top 50).



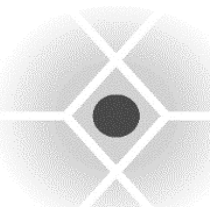
World Economic Forum annual list of Disruptive technologies of 2016 ranked Perovskite Solar Cell technology 4th out among the Top 10 break-through technologies.

Source : Magazine "Create" (Vol.2 No.08/09/2016) from Engineers Australia



"Hence, the **total cost for PSCs** (except the system costs with installation, power conditioners and so on) is estimated to be around **US\$40 per square metre, which is half the cost of silicon solar cells** (US\$80 per square metre or US\$0.5W<sup>-1</sup>). With efficiency comparable with silicon solar cells – namely, 15–20% – low-cost electric power (<US\$0.3W<sup>-1</sup>) is expected to be realized by large-scale production of PSCs. For perovskite modules with a PCE of 17%, the energy payback time can be less than 0.7yr, with an energy return factor of >8. PSCs can definitely be a major contributor to a low-carbon society."

Source : Magazine " Nature Energy" , "Towards stable and commercially available perovskite solar cells" article written by Nam-Gyu Park<sup>1</sup>, Michael Grätzel<sup>2</sup>, Tsutomu Miyasaka<sup>3</sup>, Kai Zhu<sup>4</sup> and Keith Emery<sup>4</sup>



# COMMERCIALISATION



# COMMERCIALISATION

## Competitive Advantage



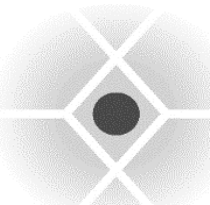
**Intellectual Property:** as an original EPFL licensee Greatcell Solar has global freedom to operate in the field of Perovskite Solar Cells. This superior position was confirmed in the 2013 Stratagem study. Patents cover core technology, device design, manufacturing processes and novel material use.



**Industrial Scale:** Greatcell Solar (leader in the development of low cost perovskite materials, deposition techniques and panel assembly) has begun prototype development and pilot line planning in collaboration with VDL Enabling Technology Group – one of the world's most sophisticated process engineering groups. Greatcell Solar is expert in advanced large area deposition, device encapsulation and sealing, and material performance optimisation. Greatcell Solar will solar enable both glass (R2R) and glass (S2S) substrates.



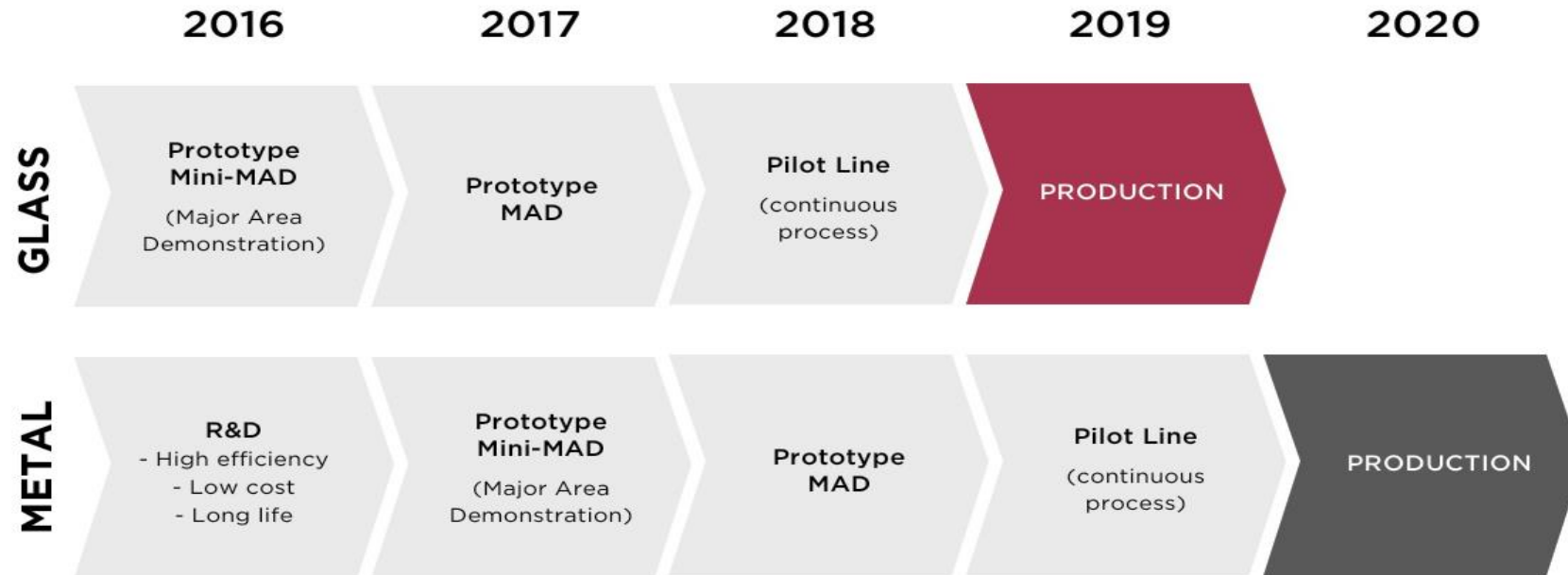
**Collaboration and Global Networking:** Greatcell Solar is the global leader in IP harvesting and, as a publicly listed company, best positioned to commercially exploit its vast portfolio of intellectual property, including know-how and trade secrets created over 900 man years. Furthermore GSL's connection with EPFL, NTU, CSIRO, Solliance, VDL and ACAP provides a formidable resource to further enhance our rapid scale-up program.



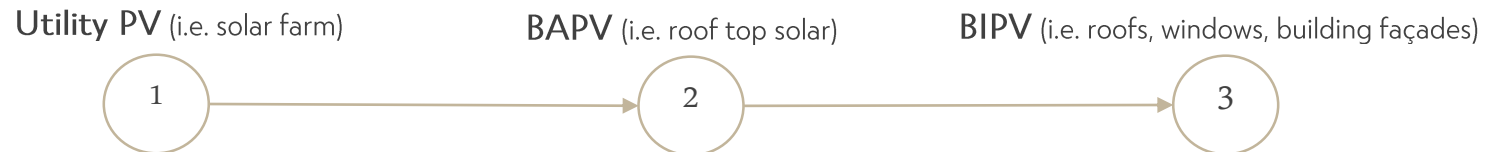
# COMMERCIALISATION

## Partnership accelerate commercialisation & GSL Product Strategy

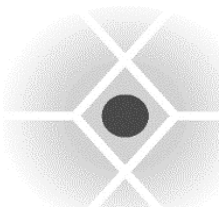
- Greatcell Solar Commercialisation Schedule



- Our Product Strategy



BIPV is the "holy grail" of PV – inter alia it eliminates installation costs and transmissions losses.



# COMMERCIALISATION

## Ongoing Projects & Partnerships



Australian Department of Industry CRC-P grant: \$2.5 million funding to develop innovative coating processes for large scale glass.



Innovations Connections grant: funding for CSIRO to develop robust cell & panel efficiency and stability testing regimes. GSL is now co-locating with CSIRO at their offices in Clayton, Melbourne, to build the prototype facility expected to be finished 2018-2019. This project is supported by a \$6 million ARENA commercialisation grant.



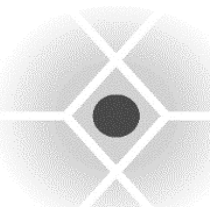
VDL Enabling Technologies Group of the Netherlands is collaborating with Greatcell Solar to develop Major Area Demonstration (MAD) panels for testing, accreditation and demonstration. VDL ETG is one of the world's most advanced process engineering companies.



Greatcell Solar is developing PSC on metals and flexibles at Solliance in the Netherlands using Roll-To-Roll (R2R) processes – world record 12.6%. GSL is in discussions with leading metals companies to jointly develop this technology for commercialisation.



In August 2017, Greatcell signed a non-exclusive Memorandum Of Understanding (MOU) with Jinko, the World's largest solar panel manufacturer. Jinko will evaluate our prototypes with the long term aim of entering into a formal agreement with Greatcell to commercialise the technology and establish large scale manufacturing if the test results are satisfactory.

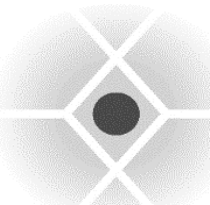
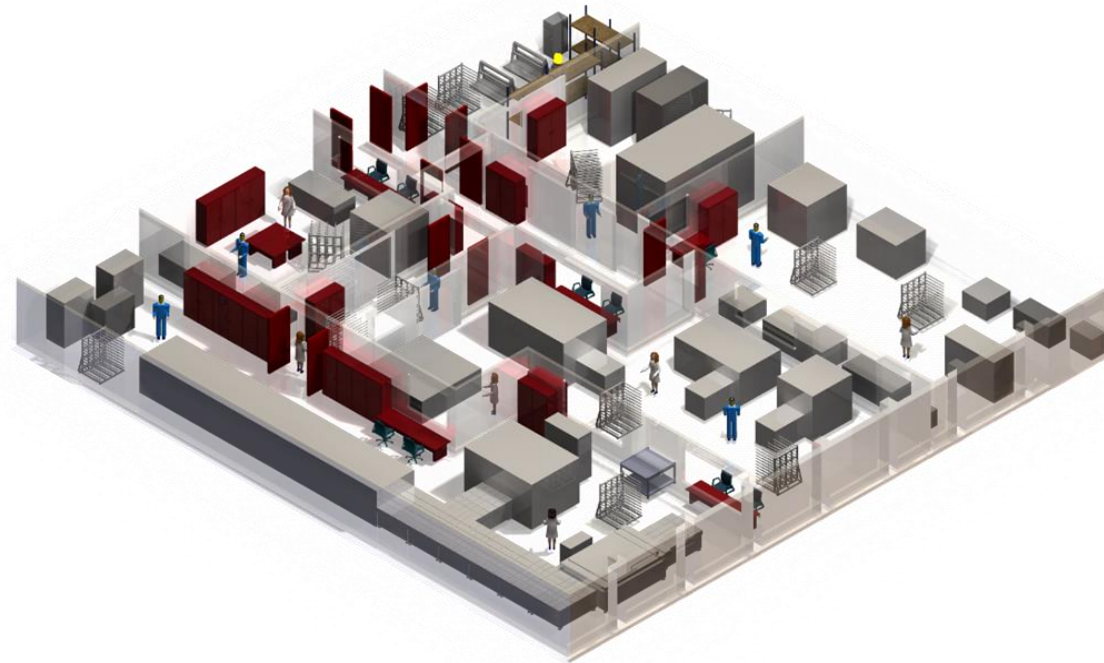




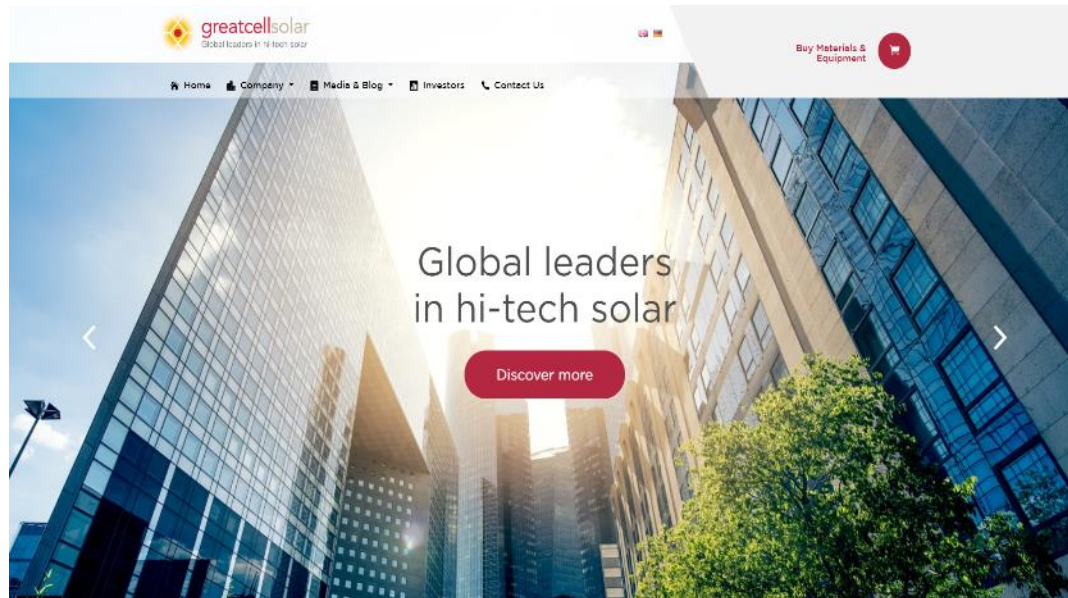
# MAJOR AREA DEMO PROTOTYPE FACILITY

Transitioning from retail-based operational funding to project funding & bringing everyone to the table

- GSL in voluntary suspension to guarantee funding at fair price
- GSL is establishing a world-class \$17M prototype project with CSIRO at Clayton
- Our key stakeholders include Tasnee, ARENA, CSIRO – all are engaged for next round funding
- New potential stakeholders include Institutions & strategic partners
- A fully refinanced GSL expected by April 30



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(New website to be launched soon)



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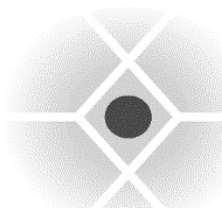


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