DYESOL (AU:DYE) – The Scale-Up and Commercialisation of Perovskite Solar Cells

Richard CALDWELL, Managing Director

GPVC, Gwang Ju KOREA, 16th March 2017

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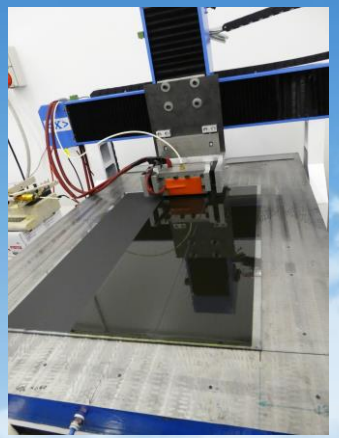
DYESOL – THE BUSINESS

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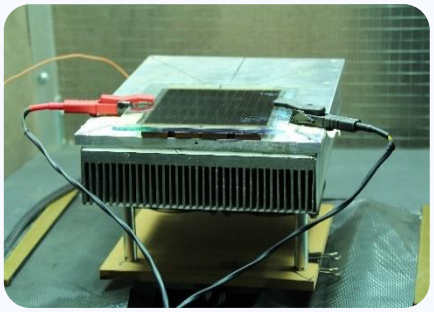
PRINCIPAL BUSINESS ACTIVITIES



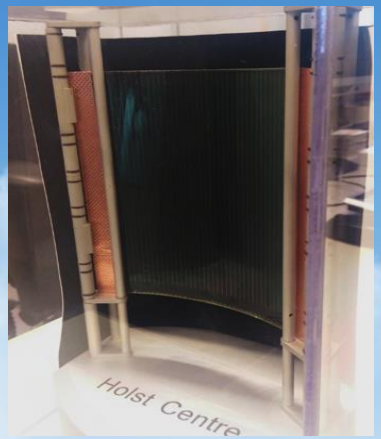
The Global Leader in the Development & Commercialisation of Perovskite Solar Cell Technology

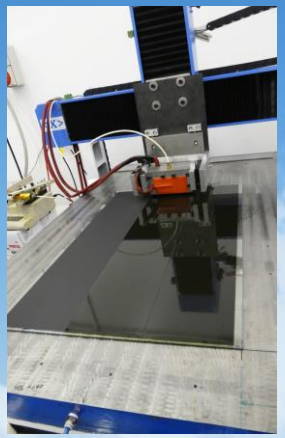
- Dyesol seeks to upscale and commercialise its 3rd generation PSC PV technology with the assistance of in-country government financial support and suitable local manufacturers and distributors in joint venture.
- Dyesol is a disruptive technology enablement company with a multi-generation Technology Development Plan to bring successive generations of improved technology to the global PSC PV market.
- Dyesol is currently engaged in prototyping with plans to pilot line in 2017/18.
- Current commercialisation discussions are in Australia, Europe, UK, Turkey and China.
- Dyesol has an independent Stratagem Freedom To Operate study that demonstrates global IP superiority.

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

- Dyesol 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.
- Dyesol has the largest market share for the global supply of related specialty chemicals, including perovskites, mesoporous titania, inorganic hole transport materials & stabilising additives.
- Dyesol also supplies equipment and laboratory solutions, including LED solar simulators.
- Dyesol has excess capacity to scale materials production to commercial quantities for mass manufacture.

DYESOL - TECHNOLOGY & ITS BENEFITS





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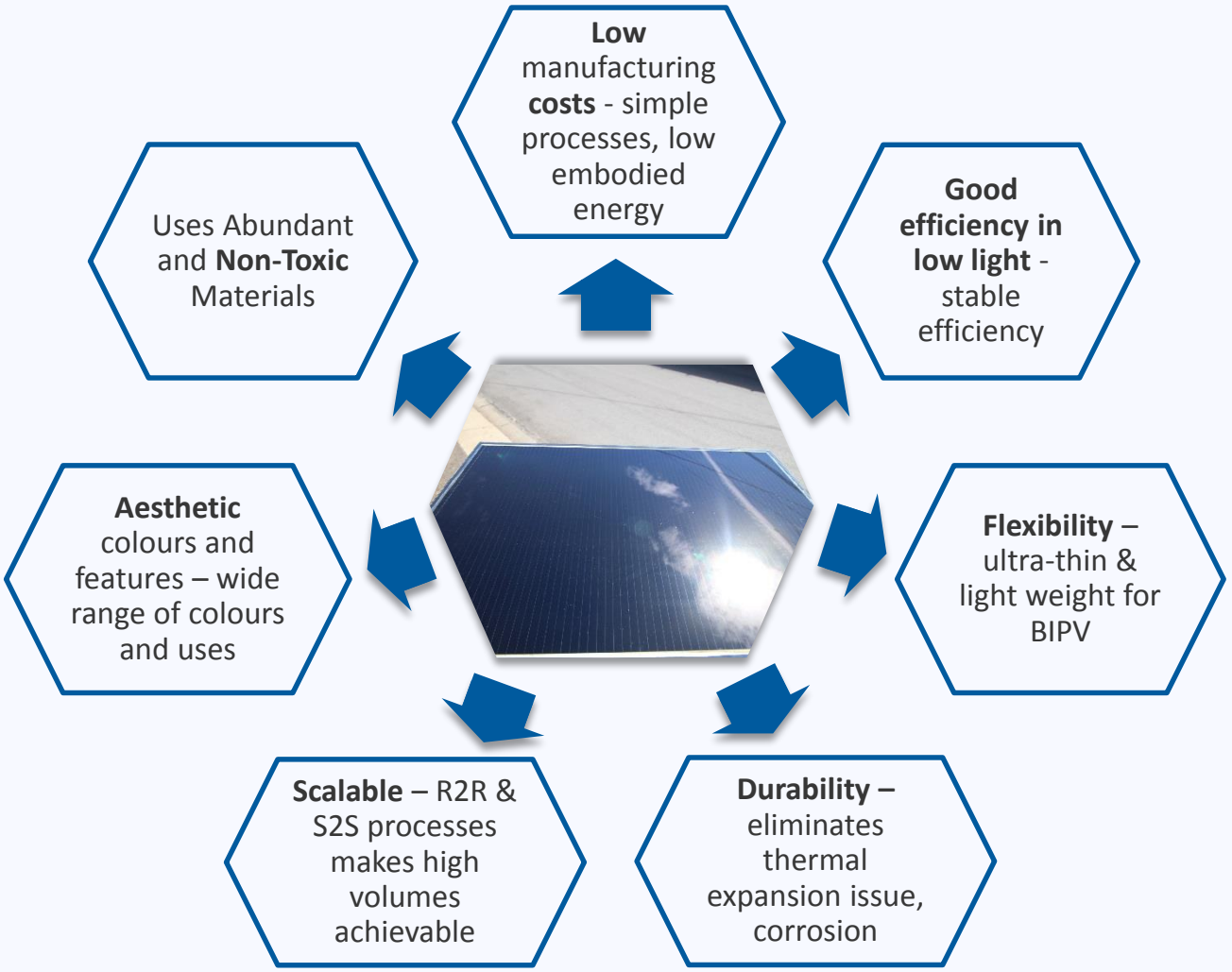
ITS BENEFITS



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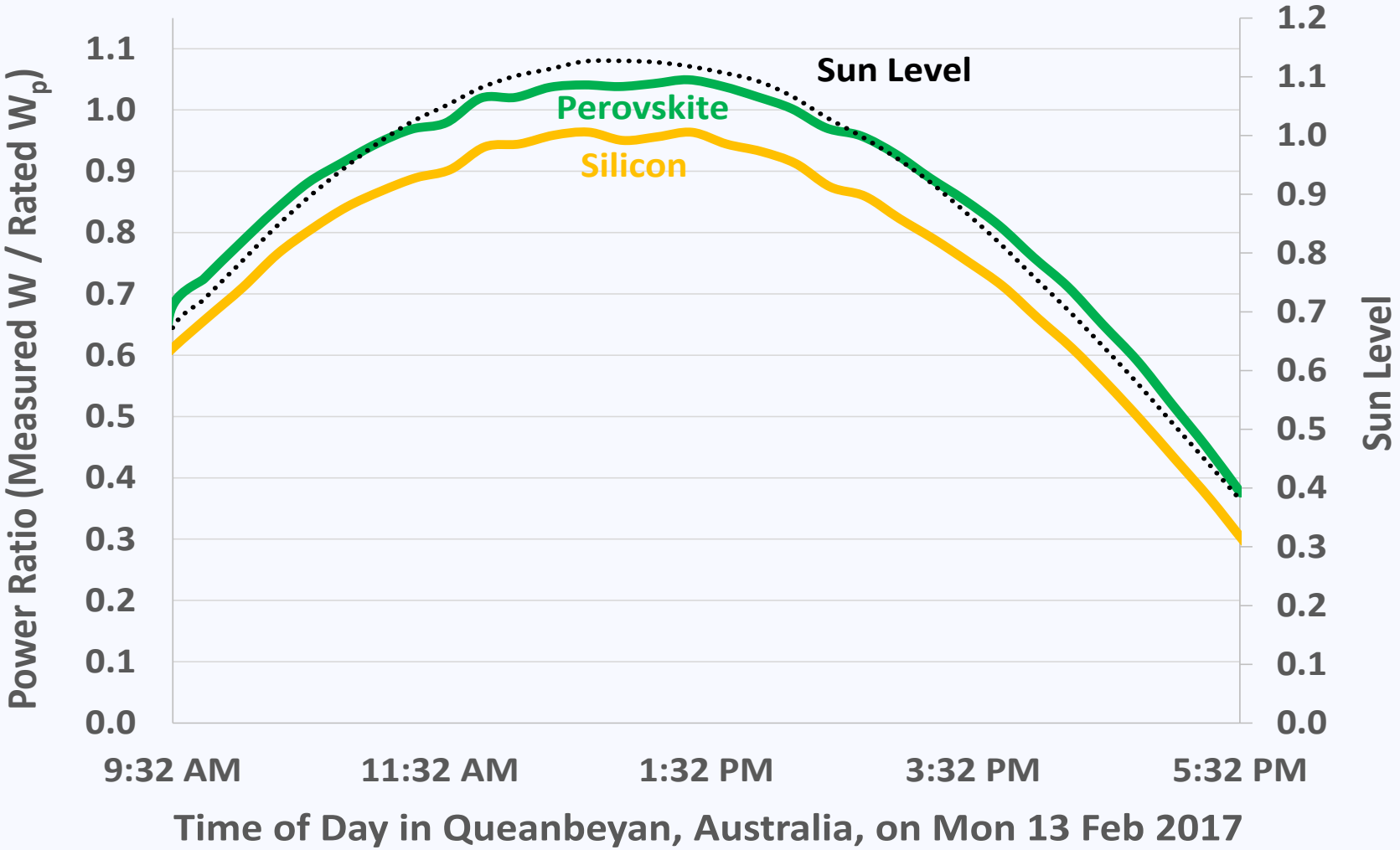
SUPERIOR LIGHT HARVESTING



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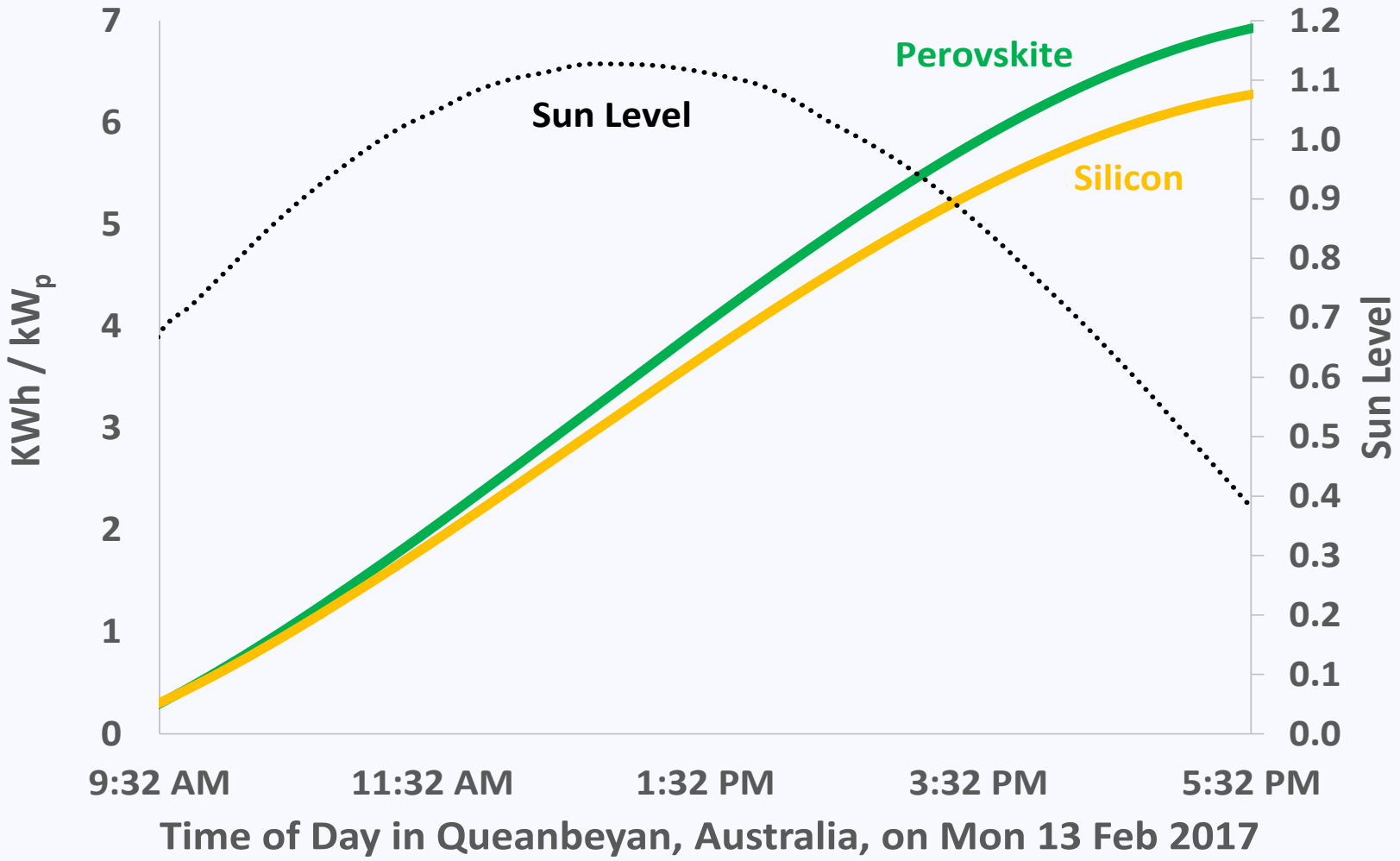
HIGHER ENERGY YIELD



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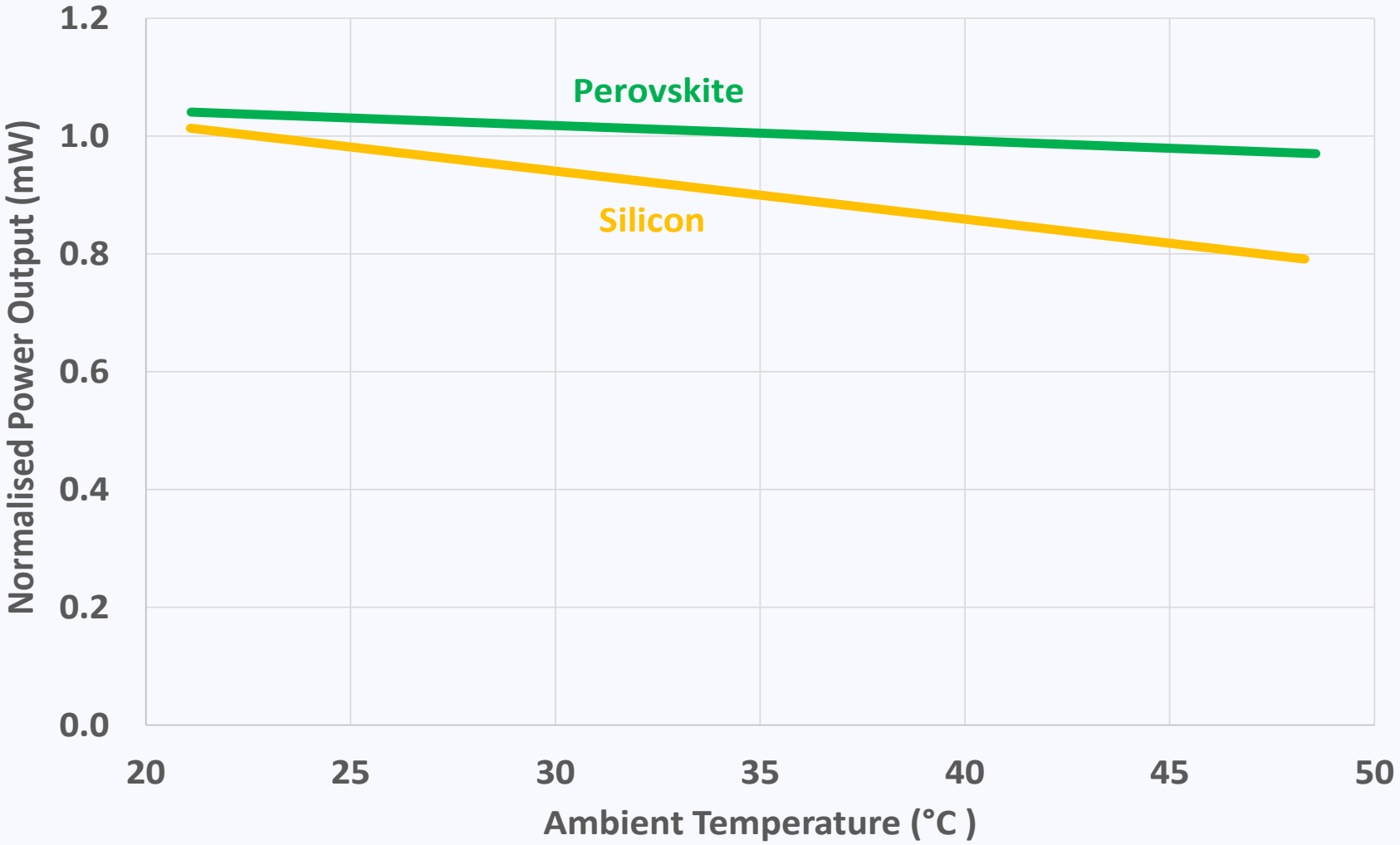
LOWER TEMPERATURE COEFFICIENT



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IN THE PRESS

FINANCIAL REVIEW 2016 most INNOVATIVE companies

Dyesol ranked 5th over 1000 Australian companies in **Australian Financial Review Innovation Award**.

WORLD ECONOMIC FORUM

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*

nature energy

"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$80 per square metre or US0.5W^{-1}$). With efficiency comparable with silicon solar cells — namely, 15–20% — low-cost electric power (<US0.3W^{-1}$) 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 Park1, Michael Grätzel2, Tsutomu Miyasaka3, Kai Zhu4 and Keith Emery4*

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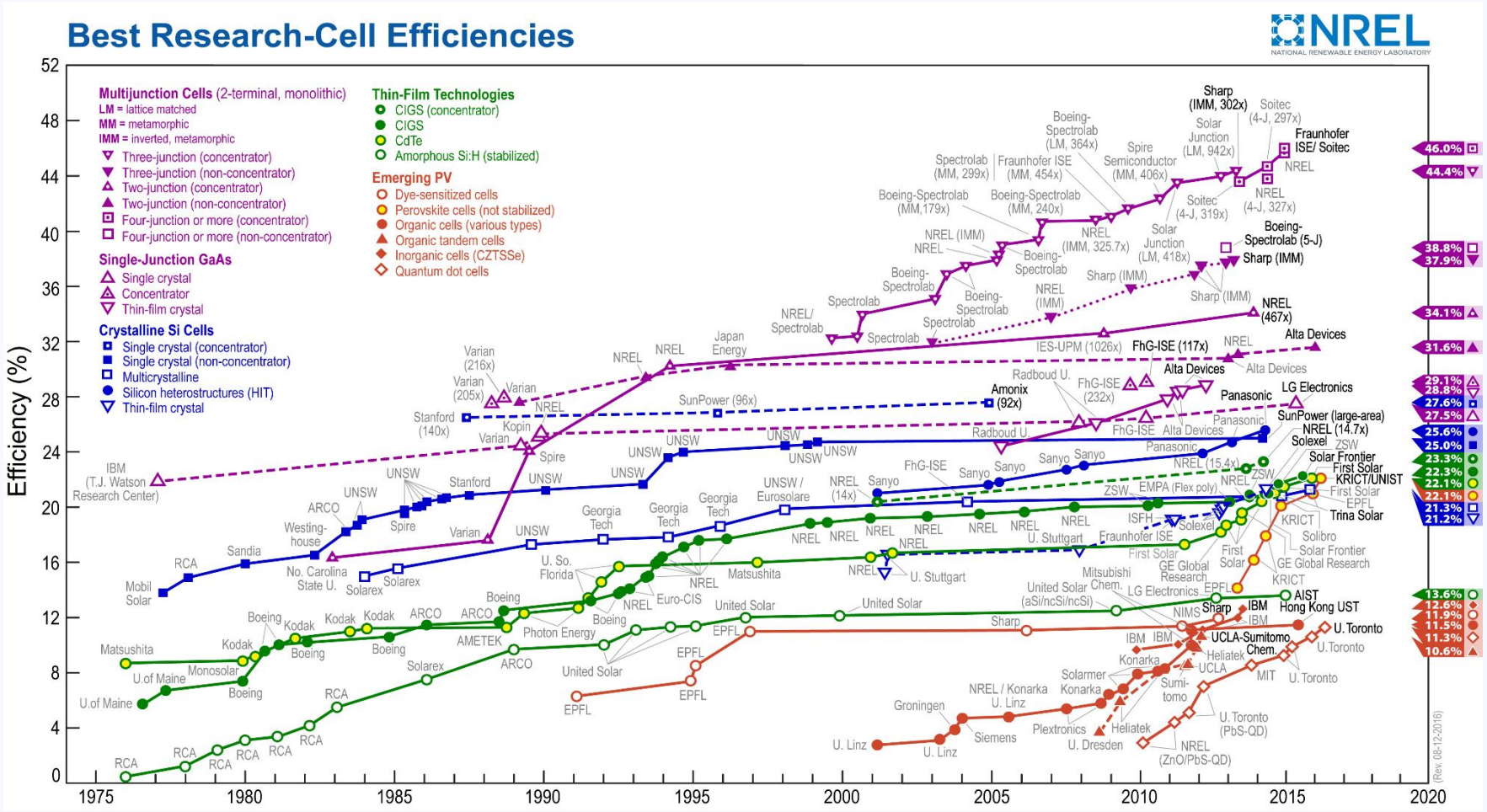
PROVEN PERFORMANCE

Since mid-2012, demonstration of a **rapid efficiency improvement from PSC technology**



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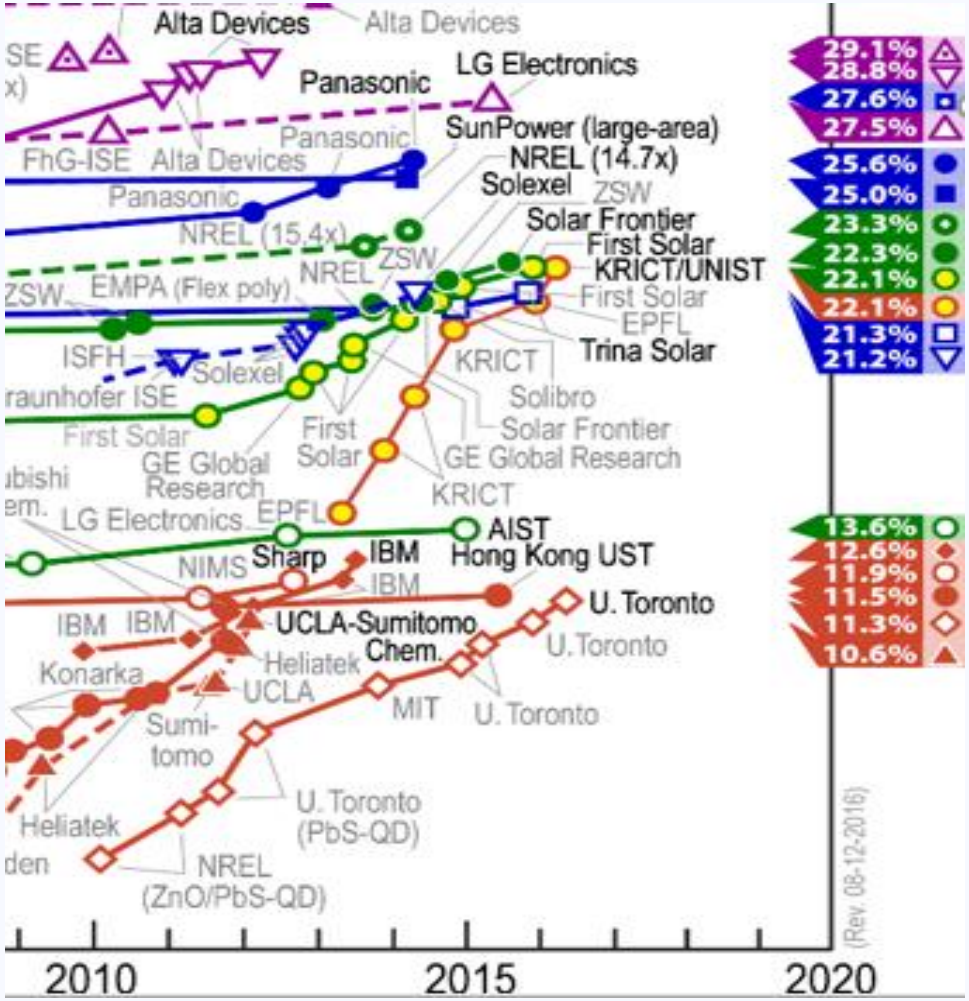
PROVEN PERFORMANCE



- ✓ EPFL & KRICT are the lead R&D institutes pushing laboratory efficiencies from 12% to 22% in 5 years. However, these are not stabilized.
- ✓ Academics have projected that laboratory "hero cell" efficiencies may rise as high as 33%.
- ✓ Dyesol focuses on producing cheap and durable panels with low-cost materials and addressing all relevant tests under IEC 61646/61215 in larger devices.
- ✓ The lead candidate for commercialisation is the Porous Carbon design which focuses on an inorganic material set delivering high stability and durability.
- ✓ 12% – 15% industrial efficiencies are projecting LCOEs < A$0.08

DYESOL - GAME CHANGING TECHNOLOGY





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MARKET PROJECTIONS FACTS

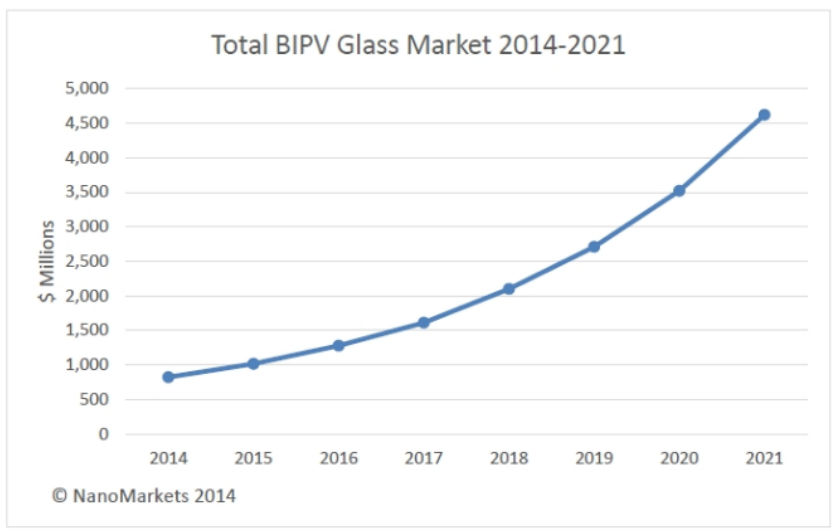
Potential for Alternative Technologies

- ✓ Global PV demand grew by 46% & exceeded 73 GW in 2016.*
- ✓ The Global Alternative Photovoltaic Solar Cell Technologies market is expected to reach $38.25 billion by 2022 growing at a CAGR of 11.30% from 2014-2022.**
- ✓ The EU has directed by 2020, all buildings in the EU should include a net zero energy component.
- ✓ In the US, all new commercial construction in California will be zero energy building (ZEB) by 2030.

*Source: *Top Solar Industry Trends for 2016, IHS*
**Source: *August 2015 – Statistics, MRC*

BIPV potential

- ✓ PSC is a game-changer – enabling all building surfaces, in all directions, to be used to generate clean energy, even in low-light.
- ✓ Global BIPV market set to grow to more than US $6 billion by 2017 and nearly $ 23 billion by 2021.
- ✓ Growth in BIPV will be at the expense of conventional solar panels in the market today.
- ✓ Eliminates transmission losses and installation costs.



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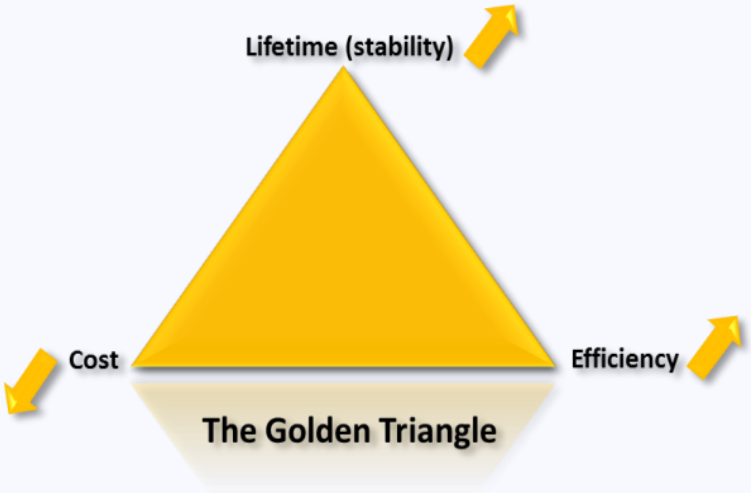
MARKET SHARE DRIVERS

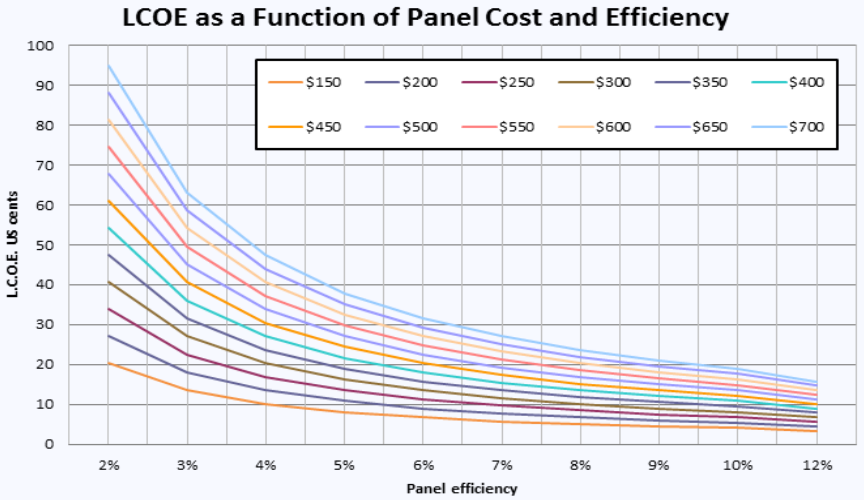


"Golden Triangle" = Cost, Efficiency, Life

Solar competitiveness measured by the 'Golden Triangle' = Cost, Efficiency, Life

Achieving the Golden Triangle is critical to capture of market share.

High efficiency, low cost and 20 year+ life span will open up the 'holy grail' of solar – BIPV.



Levelised Cost of Electricity (LCOE)

LCOE catalyst for market share capture.
Calculated by summing all the costs incurred during the lifetime of the project expressed in dollars per kWh ($/kWh). Currently projected @ < US$0.035 – 0.049*/ kWh. Allows a comparison between different generating technologies and unequal lifetimes to be made.

*Source: Professor Han NIMS 2016

DYESOL - COMMERCIALISATION





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Perovskite Solar Cell is a unique technology that :

- ✓ Can be integrated into glass, metal, cement and polymeric building materials;
- ✓ Can generate energy even in low light conditions.

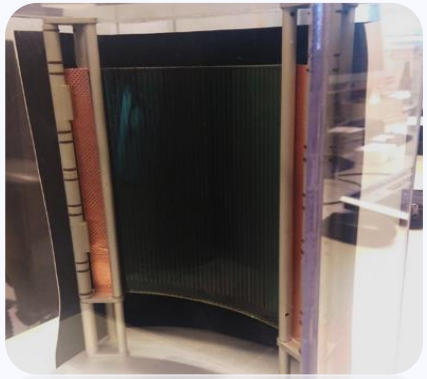
Our Product strategy is :

1 Utility PV (i.e. solar farm) → **2 BAPV*** (i.e. roof top solar) → **3 BIPV*** (i.e. roofs, windows, building façades…)

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

1 Utility PV

2 BAPV



3 BIPV

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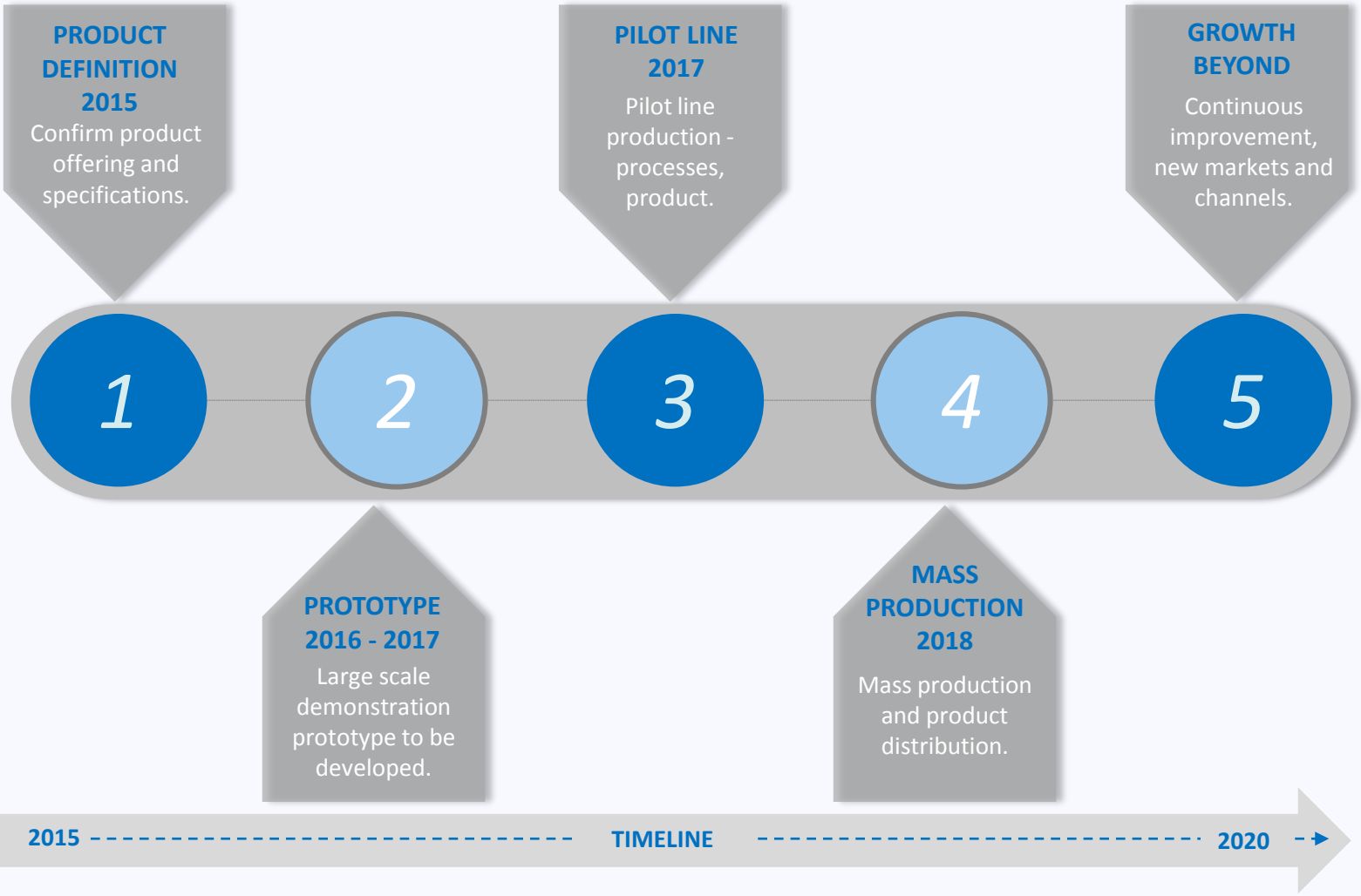
COMMERCIALISATION SCHEDULE



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ON GOING PROJECTS & DYESOL'S PARTNERSHIP

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.

VDL Enabling Technologies of the Netherlands is collaborating with Dyesol 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.

Dyesol is developing PSC on metals and flexibles at Solliance in the Netherlands using Roll-To-Roll (R2R) processes – world record 12.6%.

Dyesol 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.

Dyesol Partnership Experience:

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DYESOL FUTURE DEVELOPMENTS & PROJECTS

- Mini-MAD targeting high industrial efficiencies & LCOE of < A$0.08 by mid-2017.
- Intense focus on staged de-risking of technology - MAD prototype 2016/17 & pilot line 2017/18.
- Technical Advisory Board milestones ongoing – MPPT efficiencies and stability.
- Further efficiencies improvement likely through technical break-throughs in new surface treatments and particle size optimisation.
- Development projects in discussion in Australia, Turkey, China, Hungary and UK.
- Solar profitability is heavily dependent on economies of scale and the Chinese government and manufacturers understand this:

  " China's National Energy Administration – which oversees energy policy – has apparently outlined a **100 GW installation target for solar by 2020** under the country's five-year plan for 2016-2020. However, analysts and industry experts view this number as being relatively conservative, and it's widely expected that the target will be much higher when the plan is officially announced."

  Source : https://www.forbes.com/sites/greatspeculations/2015/11/10/the-opportunities-and-challenges-in-the-chinese-solar-market/#6ffc23bdc8aa

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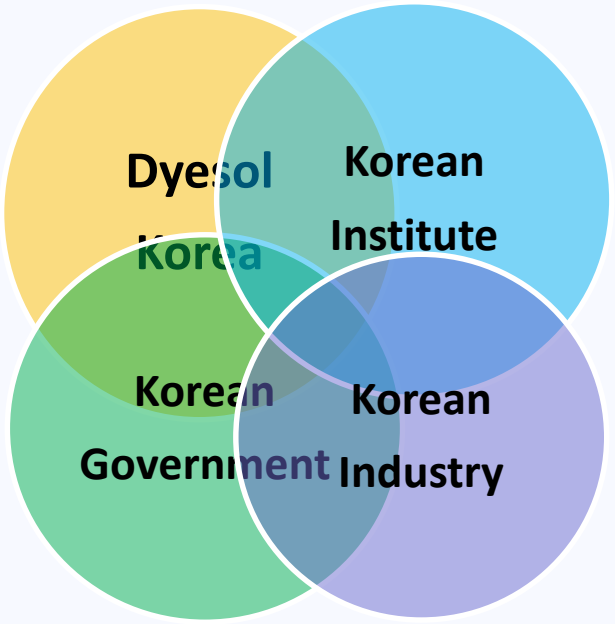
MODEL FOR KOREAN COLLABORATION

1. Dyesol Korea (D-T) was established in 2008 & has received US$8.9 million Korean Government grants.
2. Next Generation Technology will be driven by strong academic R&D
3. Strong government financial support at scale-up for prototype and pilot line stages.
4. Corporate partnership through 50/50 joint venture for manufacture and distribution.
5. Dyesol will provide access to Intellectual Property (patent and know-how), Next Generation technology and capital contribution at mass manufacturing stage – looking to scale to 1 GW production.



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