



Light, durable and potential for significant growth

- ❖ Verditek's core lightweight solar PV business is positioned in an attractive secular growth market with strong regulatory and technological drivers
- ❖ Recent management changes have resulted in the company focusing on sales execution and moving the business into the initial phase of commercialisation
- ❖ With first orders for its solar PV modules already in place, the company should report its first revenues later this year
- ❖ Recent contract wins in the oil & gas and mining sectors will act as reference contracts for future wins in the off-grid solar market
- ❖ In addition to energy and mining, significant opportunities exist for Verditek's light-weight and durable solar PV product in the marine, telecoms, residential housing, commercial real estate and transport sectors
- ❖ From its plant in Italy, the company has sufficient manufacturing capacity to produce up to 60 MW per year of solar modules (based on triple shift production)
- ❖ The Paragraf joint development program (JDP) to produce a graphene-integrated solar PV cell provides a source of substantial optionality within their solar business

The Elevator Pitch



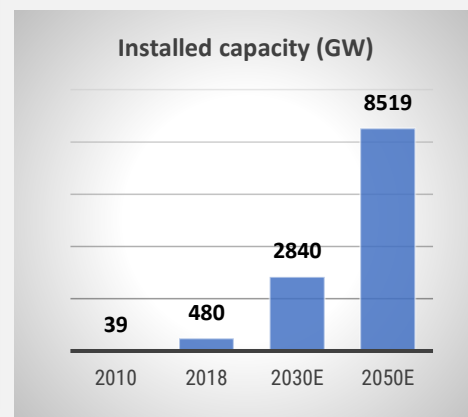
Key stats.

Sector:	Alt. Energy
Listing:	LSE – AIM
Head Quarters:	London/UK
Country of inc:	England & Wales
ISIN:	GB00BF2C0424
Admission date:	10 th August 2017
Governance code:	QCA

The Tick List

- Niche player operating within a sector with a very large addressable market ✓
- Competes on product and specific applications rather than price ✓
- Core product (solar PV modules) IEC certified for international use ✓
- Manufacturing facilities fully operational with limited impact from Covid-19 ✓
- A shift in focus from technology development to commercialisation ✓

Total solar market (IRENA ests.)

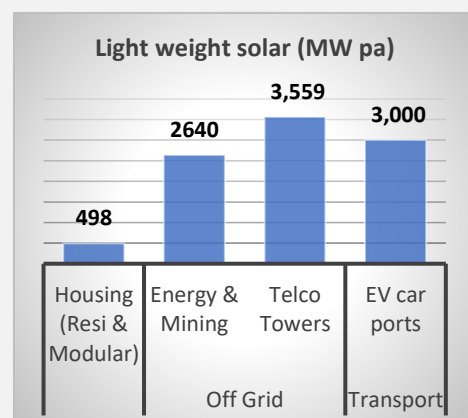


Summarised revenue scenario for Verditek Solar (SEAL estimates)*

Assumption	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Capacity (MW)	60	60	60	160	160	160
Capacity utilisation	5%	25%	65%	39%	51%	67%
Volume sold (MW)	3	15	39	62	82	107
Price/MW (£m)	1.12	1.04	0.97	0.90	0.84	0.78
Revenue (£m)	3	16	38	56	69	83

*See page 13 for details of the derivation of the estimates

Addressable markets (SEAL ests.)

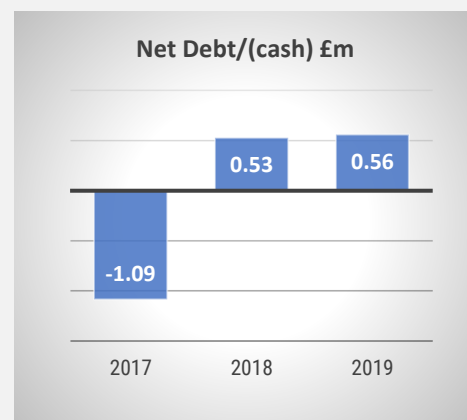
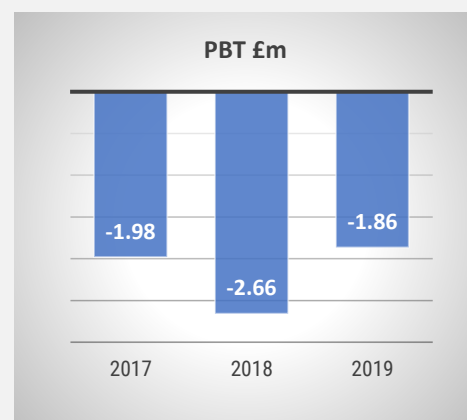
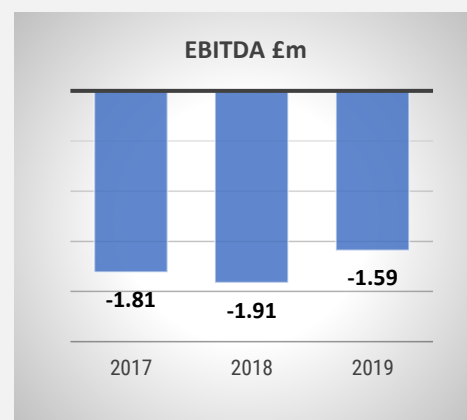
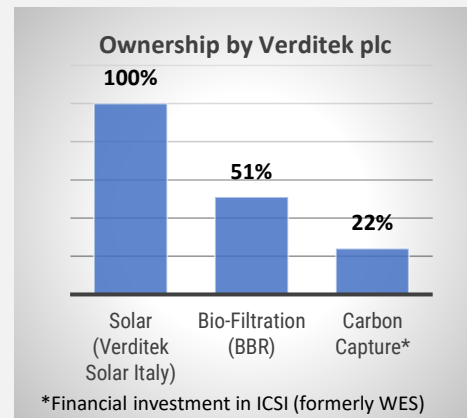




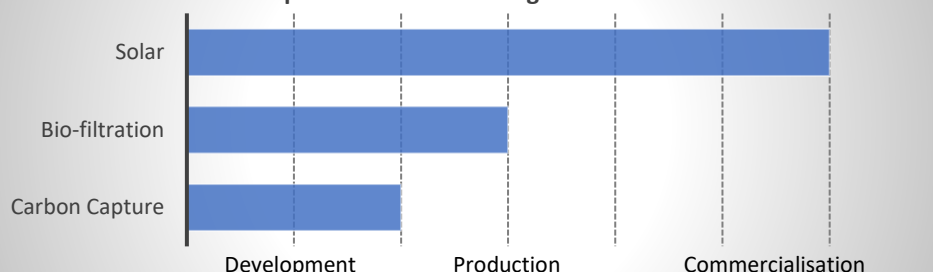
About Verditek

Verditek is a clean technology company primarily focused on the solar power sector, with interests in bio-filtration and carbon capture. At IPO, Verditek comprised a 51% stake in Greenflex Energy, which in turn owned 100% of Verditek Solar Italy, a manufacturer of lightweight solar PV; a 23.6% stake in Westec Environmental Sols LLC (WES), a patented absorption technology that optimises mass transfer of gas and liquid with applications in industrial emissions control and carbon capture; and a 51% stake in BBR Filtration, a licensed bio-filtration de-odourisation. Verditek has subsequently taken full control of the Italian solar PV manufacturer, with Greenflex Energy becoming Verditek Solar (Italy). In October 2018 WES was acquired by the Canadian company, ICSI, with the result that Verditek's stake in WES became a 22.2% stake in ICSI. Verditek has also entered into a Joint Development Programme (JDP) with Paragraf, a Cambridge-based company focusing on the disruptive potential of graphene, with the aim of developing a graphene-integrated solar PV cell. In June 2019 this aim was achieved, with the Paragraf JDP announcing that it had created the world's first graphene integrated PV cell. Following this achievement, Verditek and Paragraf signed a second JDP with the aim of commercialising the technology. In May 2020 Rob Richards was appointed CEO of Verditek, which arguably marked a turning point in the company as it moved from development to commercialisation of its core solar business.

Key data



Verditek - Group investments and stages of commercialisation



SWOT Analysis

STRENGTHS

- Operating in a highly attractive secular growth area
- Competing on product rather than price in core solar market
- Multiple applications for light weight solar PV technology
- Unique GIPV solar cell-technology is a potential game-changer

WEAKNESSES

- Further significant order wins required to achieve critical mass in revenues
- Low manufacturing capacity utilisation and centred at only one facility
- Cost disadvantage relative to large global solar OEMs
- Loss-making and yet to reach free-cashflow break-even

OPPORTUNITIES

- Telco towers and rural micro-grids represent a sizeable opportunity
- Capitalise on recent order wins in the marine market
- Additional manufacturing capabilities closer to some markets (e.g. Asia)
- Commercialisation of GIPV technology via royalty agreements with OEMs

THREATS

- Lack of orders in solar would extend time to free cash-flow break even
- Single manufacturing facility increases production risk in event of shut-down
- GIPV technology may prove difficult to commercialise and/or royalty agreements may prove elusive

SWOT



❖ Corporate Strategy and near-term drivers

Verditek aims to capitalise on its innovative light-weight solar PV technology by targeting niche applications within the broader solar power market. By bonding solar PV cells to a polymer sheet instead of glass that is used in the creation of polycrystalline solar PV modules, Verditek's modules are around one tenth the weight of conventional PV modules. This makes them particularly suited for a range of niche applications where conventional solar PV modules cannot be used. An associated benefit of bonding to polymer rather than glass is that it makes the panels durable, further increasing the range of applications.

A key area for Verditek's solar products is the off-grid solar market. This is typically where there is no electric grid, or where the cost of connecting to the grid is too high to be economically viable (e.g. remote base camps for the extractive industries of oil & gas and mining). The virtue of this market is that relatively small project sizes (<10 MW) and weight restrictions means it is unsuited to the heavier conventional PV panels mass-produced by the large global solar PV OEMs. Hence, the off-grid solar market tends to be less subject to the pricing pressure, a feature of the conventional solar market. Verditek estimates that the payback period for a typical customer in the off-grid sector is 2 years.

The combination of the new CEO's experience of working with the oil & gas and mining sectors and the need for companies in these sectors to reduce costs and carbon foot-print provides an excellent opportunity for Verditek to exploit this niche. Initial orders already secured in both the oil & gas and mining verticals (SAF in Pakistan and Black Tulip Mining in Peru) should serve as reference contracts for further orders in these markets. Other areas of focus in the off-grid segment range from remotely-sited telecom towers to rural micro-grids. This latter market has seen a ten-fold increase in volumes between 2010-2018. Interestingly, part of the recent SAF follow-on order is destined for a rural micro-grid in Pakistan, giving Verditek an in-road into this sizeable and fast-growing niche. Agriculture is another niche opportunity within off-grid solar, with Verditek's products suited to low-load bearing agricultural buildings located far away from the grid.

Other addressable new markets include the electric vehicle (EV) charging infrastructure market and modular residential construction sector, both of which have the potential for strong growth. **Verditek's estimates that its serviceable addressable market (SAM) to be c5% of the 100 GW per year of total solar installations, equivalent to £5bn per year.**

Verditek's modules are significantly lighter and more durable than conventional PV modules

A key area for near term growth is the off-grid solar market utilised by the oil & gas and mining sectors

Contracts already secured with SAF and Black Tulip Minerals

Verditek's serviceable addressable market estimated at c£5bn per year

❖ Strategy simplified



❖ Longer-term drivers

The optionality around graphene-integrated photovoltaic cells (GIPV) and the JDP with **Paragraf** is significant. Here, the aim is to licence the technology to consumer electronics OEMs for incorporation in their own products in return for an ongoing royalty fee. Mobile device OEMs (handsets/tablets/laptops) are the key target group. It is envisaged that a GIPV-enabled device would be able to trickle-charge whilst in use, significantly extending battery life. Longer-term, Verditek's equity interest in the **Bio-Filtration** and **Carbon Capture** technology businesses could also represent a source of value.

Significant opportunities in graphene. Sources of value in carbon capture and filtration



ESG credentials

❖ Environmental

The company's products enable reductions in carbon foot-print by providing customers with flexible sources of solar renewable electricity. However, from an ESG perspective the focus needs to be on the company's operating performance and its contributions to the environment from its production activities. Solar panels can be energy intensive to manufacture as they require heat to bake the substrates and electric power to laminate. Verditek has one manufacturing plant in Italy and operates on 100% renewably sourced electricity. They currently do not disclose their total carbon foot-print in relation to output because the company has been in start-up phase and the factory has been operating at a low utilisation rate. The company has indicated that disclosure of its carbon footprint will be disclosed in the future. One cause for slight concern is the air freighting of components from Taiwan to Italy. Establishing a manufacturing site closer to its Asian suppliers would help mitigate this risk.

❖ Social

The company is in start-up mode, and while there is some diversity in the workforce of seven, the board has no female or BAME members. Verditek's products are certified for safety and sold through distributors to business customers seeking strict specifications. There are no plans to sell directly to consumers. There are currently no issues with community relations and neither the company's operations nor the products' usage create any human rights risks.

❖ Governance

The company reports against the Quoted Companies Alliance (QCA) Corporate Governance Code. It seeks to engage positively, responsibly and fairly with all of its stakeholders. The Company has been through several iterations of its senior management team as its strategy has evolved over the last few years. The CEO has only been in place since May 2020 but has significant commercial experience of the target customer base. The board includes major shareholders but would benefit from a more diverse non-executive presence. Systemic risk factors are addressed in the company's annual report but while they are not highly threatening, control processes (as disclosed) cannot be considered robust.

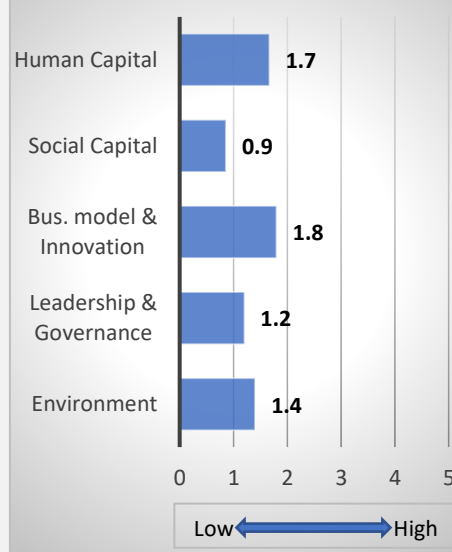
❖ Summary and conclusions

Verditek has a small environmental footprint (though this is a baseline study) and has a few steps to make on formulating and disclosing better policies in some areas of social impact. A more diverse Board would help, but there are no meaningful risks that are not being managed from an ESG perspective at the company's current stage of development.

ESG Key Performance Indicators

KPI	
GHG emissions	n/a
Total no. of employees	7
% women in workforce	29%
No. of prosecutions	0
No. of workplace incidents	0
Community spending	0
Size of the Board	4
No. of independent Directors	0
Board duration (years):	
Rob Richards (CEO)	<1 year
Lord Willets (Chairman)	2 years
George Kataros (NED)	3 years
Gavin Mayhew (NED)	1.5 years
Corporate Governance Code adopted	QCA
Political donations	0

SEAL ESG Scorecard: Avg Risk





ESG Scorecard

Risk = potential or actual ESG risk level. Range 0 to 5; 0 = low/no risk, 5 = high risk

Execution = what is being done to address the potential or actual risk. Range 5 to 0; 5 = being managed well, 0 = not being addressed

ESG Score	Risk	Execution	Comment
Environment			
GHG emissions	2	2	Too early for data to be meaningful
Air Quality	1	2	Minor concerns over air-freight of sub-assemblies
Energy management	3	5	Plant is 100% powered by renewable electricity
Water and waste management	0	0	Not applicable
Ecological impact	1	4	No impact other than PV cells on factory roof
Leadership & Governance			
Business ethics	0	0	Too early for data to be meaningful
Competitive behaviour	0	0	Too early for data to be meaningful
Management of legal & regulatory issues	2	3	Product certification progressing well
Critical incident risk management	2	2	Plans in place but yet to be tested
Systemic risk management	2	3	Limited risk. Additional non-Exec would help
Business model and innovation			
Product design & lifecycle management	3	3	Flexible PV cells expand market greatly.
Business model resilience	3	4	Will outsource/license if favourable
Supply chain management	1	3	Inputs sourced from multiple suppliers
Materials sourcing & efficiency	2	3	Limited data but low impact
Physical impacts of climate change	0	3	Not an issue
Social Capital			
Human rights and community relations	1	2	low risk but early stages of policy formation/ disclosure
Customer privacy	1	2	low risk but early stages of policy formation/ disclosure
Data security	1	2	low risk but early stages of policy formation/ disclosure
Access and affordability	0	0	Not applicable
Product quality and safety	1	3	limited history and fast changing technology
Customer welfare	1	3	Aim is to be completely B2B, via wholesale distributors
Selling practices & product labelling	1	3	Aim is to be completely B2B, via wholesale distributors
Human Capital			
Labour practices	1	2	limited evidence of policies
Employee health & safety	1	2	limited evidence of policies
Employee engagement, diversity & inclusion	3	2	limited diversity, including Board level



Verditek and the solar industry

❖ A key part of the energy source of the future

The [Paris Agreement](#) on climate change (2016) aims to keep a global temperature rise this century to “well below 2 degrees Celsius”, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius (Article 2). As part of the accord, each sovereign signatory is obliged to prepare, communicate and maintain a Nationally Determined Contribution (NDC) and to pursue domestic measures to achieve it (Article 4). It is estimated that for the core objective of the Paris Agreement to be achieved, a 70% reduction in carbon emissions would be required. This means emissions need to be reduced from the current projection of 33GT per year in 2050E to 9.8GT pa. These aims can only be achieved by a wholesale adoption of the use of alternative energy sources such as solar and wind in place of carbon emitting fossil fuels such as oil and coal.

To highlight this point, a study undertaken by the International Renewable Energy Agency ([IRENA/REmap Case](#)) finds that in order to ensure that the key targets of the Paris Climate Change Accord are achieved, renewables would need to form 86% of the power generation mix by 2050. This would require the share of electricity in final energy consumption rising from around 20% today to circa 50% over the same period. While wind is forecast to be the largest source of renewable power (set to supply more than one-third of total electricity demand), Solar is set to be the second most significant source of clean energy, supplying more than 25% of total electricity demand by 2050. For this to be achieved there needs to be a substantial increase in installed solar capacity.

As can be seen from the below, under IRENA’s ‘REmap’ scenario, solar PV installed capacity would increase from the 2018 level of 480GW to more than 8,500 GW by 2050. This represents a 9% compound annual growth rate (CAGR) between 2019-2050. Moreover, under this scenario, electricity generation from solar would supply 25% of total electricity demand by 2050E, representing a more than twelve-fold increase in penetration from 2018 and a 125-fold increase relative to 2010.

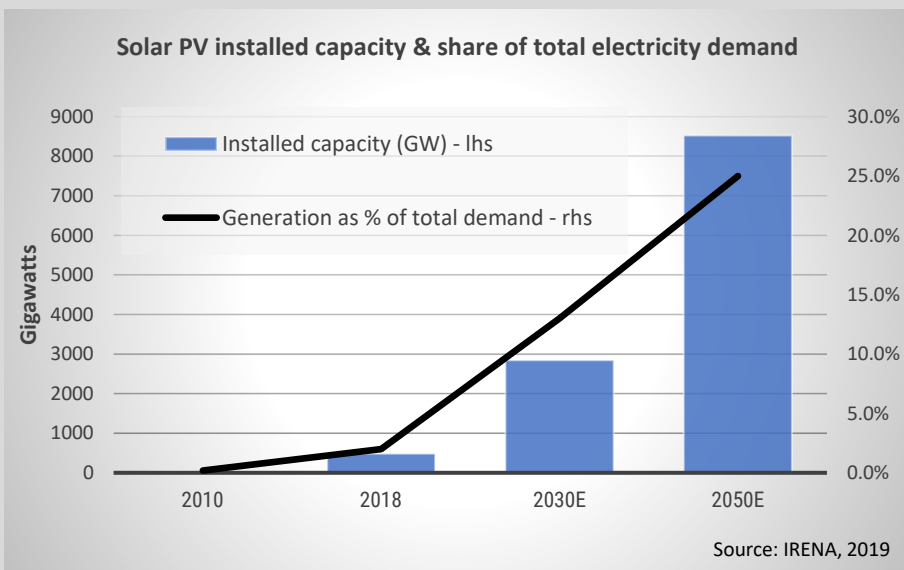
Deployment of solar on this scale would reduce carbon emissions by an estimated 4.9 Gt, corresponding to c.21% of the total envisaged carbon emissions reduction.

Adoption of alternative energy sources such as solar is the only way of achieving aims of the Paris Agreement

Renewables need to be c.86% of the power generation mix by 2050

Solar PV installations forecast to increase from 480GW to 8,500GW by 2050

Significant increase in solar power generation forecast by 2050





❖ The solar market – three main areas

The Solar market can be broken down into 3 main segments. These being:

- Residential
- Commercial
- Utility

Residential refers to solar PV installations mounted on the rooftops of private dwellings in order to supply the electricity requirements of an individual house, with excess electricity being sold back to the grid.

Commercial represents solar PV installations on the rooftops of offices and factories, as well as ground-mounted PV panels located on land zoned for industrial and commercial use.

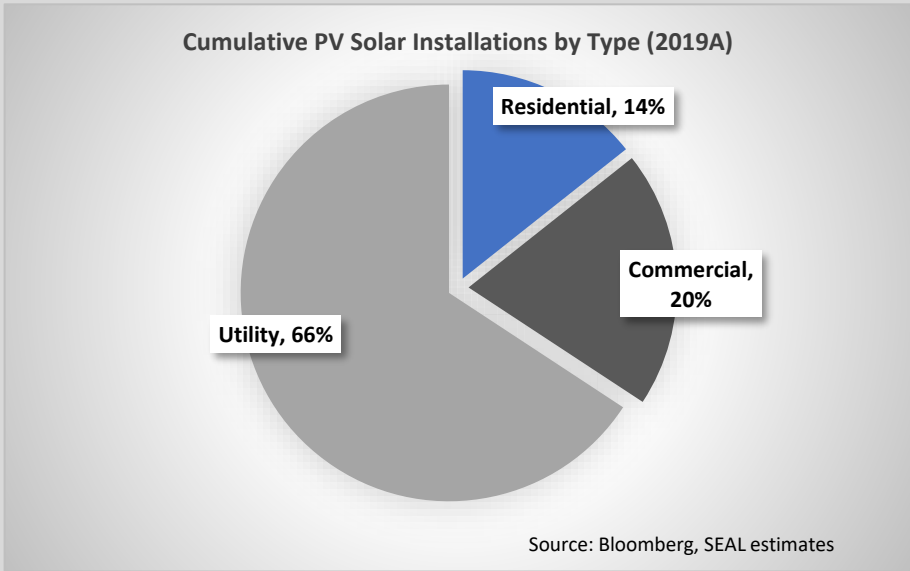
Utility, or utility-scale solar, comprises very large arrays of ground-mounted solar PV panels which supply electricity to a utility according to the terms of a Power Purchase Agreement (PPA). It is the existence of a PPA rather than a particular generation capacity which defines the boundary between utility-scale and commercial, though most commentators agree that utility-scale refers to installations with a capacity of greater than 10MW.

Of the three market segments, utility is the largest, accounting for c.66% of the cumulative solar PV installations globally. Utility has also been the fastest growing market segment, having grown at a CAGR of around 78% 2005-2019. However, in the near term, residential is expected to show the fastest growth, with an 18.4% CAGR in installations forecast over the next 3 years.

Three main areas of solar market defined as residential, commercial and utility

Utility-scale solar largest source of generation

Residential expected to see fastest growth in near term



Verditek competes in the niche areas of commercial and residential

Verditek does not compete in the utility-scale solar market, which tends to be dominated by large cap solar companies with massive manufacturing footprints and corresponding scale economies. However, it does compete in both the residential and commercial markets, with its technology offering a niche solution for use in installations where conventional solar PV panels are not suitable due to load-bearing restrictions and/or where a higher level of durability is required.

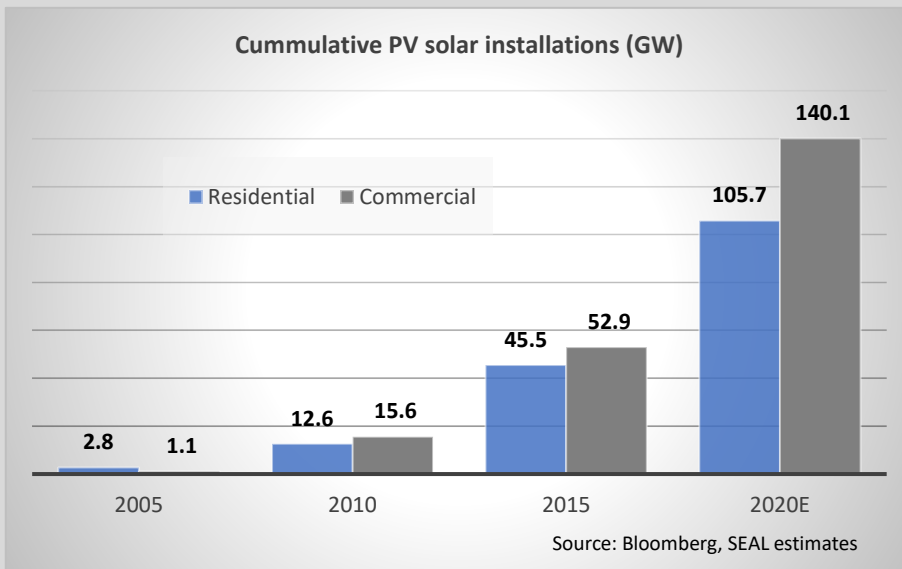


In the residential market, Verditek announced in January 2020 that it was trialling an integrated solar tiles solution with a top-tier roofing company with the aim of incorporating these into housing projects.

In the commercial market, Verditek targets a range of commercial real estate such as warehouses and industrial structures. The commercial opportunity is large, with an estimated 250k hectares of south-facing roof space in the UK alone. It is interesting to note that in Germany, PV mounted on commercial rooftops accounts for around 50% of total installed solar PV capacity, whereas in the UK only around 30% of installed capacity is from such installations. This suggests it is something of an underexploited opportunity in the UK and commercial as a whole should see double digit growth in the foreseeable future.

Verditek is trialling a solar tile solution for residential

Cummulative PV solar installations (GW)



**Scribble Sheet:
Residential and modular buildings**

UK annual completions of new build houses = 190k

% of newbuild which are houses with own roof space = 80%

% of houses suitable for solar tiles (i.e. premium houses) = 15%

Total number of suitable houses = $190k \times 80\% \times 15\% = 22,800$

Gen. capacity per house = 6kW

UK resi annual demand = 137MW

EU modular building per year = 60k

Gen capacity per house = 6kW

EU modular annual demand = 361MW

Sources: SEAL Advisors, Roland Berger

Within Commercial, Verditek is targeting niches where the products offered by larger competitors are not suitable for weight reasons, for example the roofs of certain types of distribution centres which tend to be low-load bearing. Verditek makes a point of not going head-to-head with the large global competitors on conventional panel projects, with the significant manufacturing scale advantages of the latter meaning that Verditek cannot match their prices. Another example within Commercial where Verditek's products provide a solution that cannot be addressed by conventional PV panels is the roofs of petrol stations, where panels can be used to run the ancillary power requirement.

Verditek focuses on solutions where a light weight product is needed

In addition to the traditional commercial market, Verditek is also targeting the niche (and fast growing) segment of modular construction, whose low-load bearing roofs constitute a natural market for Verditek's technology. Modular construction PV technology is often designed-in, with a large part of the selling point of such structures being the eco-friendly, low carbon footprint. The benefit of such structures being partly run on solar energy can only augment their green credentials.

Inroads into this market will necessitate agreements with modular construction OEMs, with the aim of getting a Verditek solution designed into the final product. A development in this area is Verditek's recent agreement with [Green Unit](#) to incorporate Verditek solar PV technology into the curved roofs of their modular 'ARC' buildings.

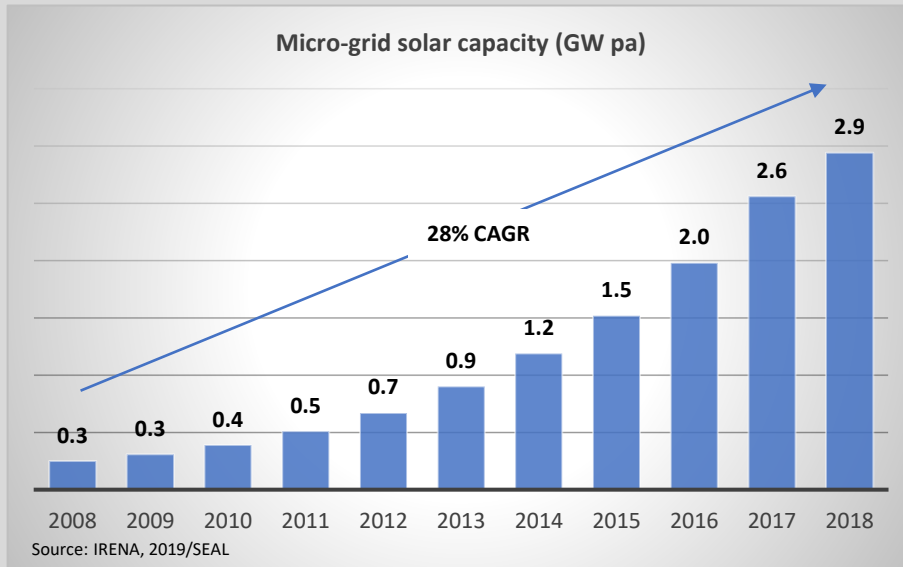
Initial progress in the modular construction market



❖ The off-grid solar niche: a large near-term opportunity

While the commercial and residential solar markets provide a good backdrop for the longer term growth prospects for Verditek, it is in the niche market of off-grid solar which would seem to offer the greatest near-term opportunity. Off-grid solar is typically used where there is no electric grid, or where the cost of connecting to the grid is too high to be economically viable. Examples might include small-scale projects in rural areas of developing countries, or alternatively base camps for extractive industries such as mining and oil & gas which are areas showing strong growth.

The off-grid market is a key market for Verditek



Micro-grid market has been growing at 28% CAGR since 2008

The extractive industries niche of the off-grid solar market is of particular interest to Verditek given the potential applications of its solar PV technology to the challenges faced by companies operating in remote environments. In such locations the conventional solution of installing a diesel generator can result in a price of power that is 3 times higher being connected to the grid (e.g. USD300/MWh vs USD100 MWh). Verditek does not aim to entirely displace conventional liquid solutions, but instead work in tandem with them to lower the overall cost of power with the Verditek solution providing power during daylight hours. An additional benefit is that diesel generators can be unreliable, so installing Verditek solar panels also improves the overall reliability of power supply.

Verditek's product designed to work in-tandem with existing power generation

Verditek received its first order in June 2020, an order from oil & gas EPC company SAF for solar modules for an off-grid application at an oil infrastructure installation camp in Pakistan. Here, Verditek panels were installed on the roofs of the prefabricated office containers, providing power for the interiors (air con etc.) during daylight hours. Two months after the installation went live, Verditek was awarded a much larger follow-on contract by the same company for six PV modules with a combined output of 1.5MW, worth USD2.2m. Verditek followed up its success with SAF with an order from Italian oil & gas EPC company Endeco for deployment in Oil & Gas maintenance camps in Libya.

First orders received in the oil & gas sector for off-grid power

The oil & gas segment of the off-grid market offers a significant opportunity for Verditek's solar products. Since each onshore drill-rig consumes on average 2MW of power for its ancillary power requirement, this could represent a +800MW pa opportunity. Since these drill rigs have to be moved every 4-6 weeks to ensure constant production rates, installing conventional PV panels is not suitable since they often get damaged when the rigs are



Moved. Verditek's polymer-based solar module offers a natural solution to this problem, being light weight and durable. Additionally, the offshore industry represents a significant opportunity. Energy usage in offshore drilling rigs can be split into that required for the actual hydrocarbon extraction process (e.g. driving pumps for extraction of oil & gas /reinjection of water) and ancillary uses (eg. heat and light for living quarters). A study carried out using the example of an FPSO ('Floating Production Storage and Off-Loading' vessel) located offshore Angola replacing diesel generators for powering the laundry systems in the living quarters with solar PV found a cost saving of c.39% based on a 20-year operations period. (Source: 'Solar Power for Sustainable Offshore Petroleum Exploration and Production in Africa' by Tawiah, S., Marfo S.A. and Benah, D. Jnr., 2017).

The Mining sector faces the same challenges with regard to off-grid power – and hence offers the same opportunities for a novel PV solar solution. Verditek has made initial inroads into this market, announcing in July 2020 that it had been awarded its first contract in the mining vertical, with Black Tulip Minerals placing an order for EUR0.2m worth of solar PV modules. This will be used as part of a diesel-hybrid system at a mining camp in Los Lomas, Peru. The combination of PV panels with diesel generators is set to significantly lower fuel consumption. In September 2020, they announced their first order in the Australian mining sector with a contract to supply 75kW of lightweight solar PV as part of a diesel-hybrid solution at [InterGroup](#)'s gold mining exploration operations in Queensland. Commentary from the company suggests that the order size could ultimately be scaled up to 1.5-2MW.

Other areas of the off-grid segment that are suited to Verditek's solar technology include; **Telecom towers, Agriculture and Defence.**

Within the telecommunications market, Verditek estimates that there are thousands of towers sited in remote locations which are currently running off expensive diesel generators. Usage of Verditek technology would both reduce operating costs, as well as the asset owner's carbon footprint. In January 2020, Verditek announced it was trialling its modules with a large global equipment supplier in order to try to tap into this opportunity. In the agri-sector, Verditek announced in July 2020 a contract win for solar PV panels for installation on the roofs of agricultural structures located at some distance from a grid connection. In Defence the company announced in September 2019 it was targeting a military application for its solar technology, which we understand to be for use in forward base camps.

Oil & gas sector presents significant opportunities for Verditek's solar products

Mining also a key sector for the off-grid solar market

Other off-grid markets include telco towers, agriculture and defence

Scribble sheet: quick analysis of the off-grid market potential

Oil & Gas	Mining	Telecom towers
Number of operational rigs = 2000	Active Exploration camps = 2300	Number of off-grid Telecoms towers = 390k
Power needed per rig (all day) = 2MW	Power need per camp = 4MW	Power needed per tower = 1kWh per day
Addressable % of rigs p.a. = 20%	Addressable % of camps per year = 20%	Per tower = 0.37MW p.a.
Addressable MW per rig = 0.4	Addressable MW per camp = 0.8	Total MW = 71.2MW pa
Total addressable market p.a. = 800MW	Total addressable market p.a = 1840MW	Addressable % of towers p.a. = 5%
		Total addressable market p.a. = 3,589MW

Sources: SEAL Advisors, Baker Hughes, Roland Berger, GSMA, Bloomberg, Statista



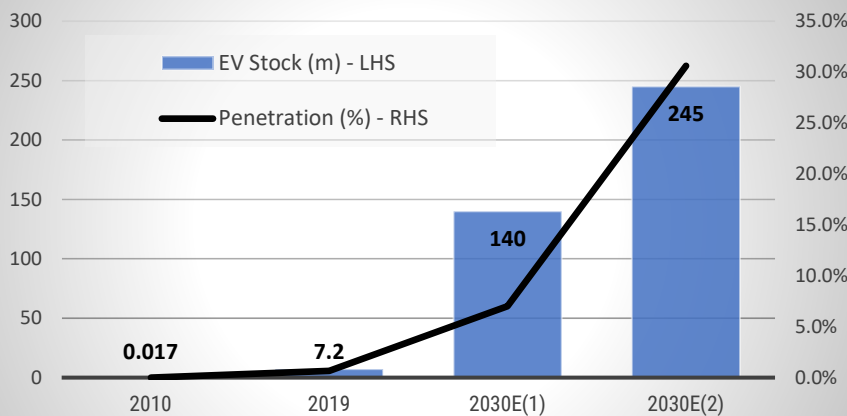
❖ Transportation: large market, disruptive technology

Solar PV technology is increasingly being utilised for niche applications in various areas of the transportation sector. In this sector Verditek has so far announced three development programs in which their product is being trialled:

- a 3 month trial with a UK based light commercial EV OEM using Verditek's lightweight solar PV panels on its single platform eCargo model to extend battery range
- a paid trial with the Dutch engineering company IM Efficiency to incorporate Verditek solar PV technology on conventional trucks as a retrofit solution in order to reduce total emissions and improve fuel consumption
- A distribution agreement with Softmetal to prove and sell a solar PV solution for perishable goods vehicles, such as refrigerated trucks for the food distribution industry

Verditek is active in various parts of the transportation sector

Forecast growth of global electric vehicle (EV) ownership



2030E(1) = stated policies scenario

2020E(2) = sustainable development scenario

Source: IEA Global Vehicle outlook, 2020

EV charging infrastructure could be a very large market

Along with the continued growth in EVs comes the requirement for a large-scale build-out of EV charging infrastructure. It is estimated that of the 7.3m chargers in operation worldwide, around 6.5m (or c.89%) are light-duty vehicle slow chargers. As EV penetration increases, there will need to be a corresponding build out of fast chargers available for use in public spaces, notably parking infrastructure .

Verditek's lightweight solar PV products could constitute a key component in innovative easy to install charging solutions for electric cars, buses and trucks. The aim here would be to partner with manufacturers of EV carport charging canopies to supply the PV panel which provides the electricity source for the charger. Such a charging solution could, be offered to owners and operators of parking facilities as a supplemental revenue stream. There are 60m off-street parking bays in Europe, and each bay would require an estimated 2KW in terms of generation capacity, which highlights the size of the potential addressable market for EV charging facilities.

The other area of the broader Transportation vertical where Verditek has seen some initial success is Marine. In July, Verditek secured a retrofit contract with a Thailand-based company (Octopus Marine) to provide its technology to power cabin electrical loads (such as navigation, lighting and comms equipment). This follows on from an earlier order win in Australia. The company estimates that the market opportunity here could be equivalent to 150-250 MWs pa.

Scribble Sheet: EV charging infrastructure - carports

Total number of car parking bays in EU = 60m

Power needed per bay to charge an EV = 2KW

Total potential MW (p.a) with 100% conversion = 120GW

Addressable % of bays p.a. = 2.5%

Total addressable market p.a. = 3,000MW

Sources: SEAL Advisors

Initial success in the marine sector



❖ Competitive landscape

In terms of competition, the solar PV sector can be split into the following main groups:

- Polysilicon Manufacturers** – includes; Daqo (China), GCL-Poly (China), OCI (South Korea), Wacker Chemie (Germany) and Xinte (China)
- Wafer Manufacturers** - includes; JA Solar (China), Longi Green Energy (China), Shin-Etsu (Japan), and Siltronic (Germany)
- Solar Cell Manufacturers** - includes; Canadian Solar (Canada), JA Solar (China), Jinko Solar (China), Longi Green Energy (China), Motech (Taiwan), Q Cells (South Korea), Tongwei (China), Trina Solar (China), UREC (Taiwan)
- Solar Modules** – includes; ; Canadian Solar (Canada), JA Solar (China), Jinko Solar (China), Longi Green Energy (China), Q Cells (South Korea), SunPower (US), Soltech (Sweden), Trina Solar (China), UREC (Taiwan) and Vivint Solar (US)

As can be seen from the examples given, there is a tendency towards vertical integration within the broader PV manufacturing space, with wafer manufacturers also involved in solar cells and modules, and - more commonly - solar cells and solar modules being manufactured by the same company.

Tendency to vertical integration within the solar industry

Sector dominated by Asia-based companies

Verditek only operates in the solar module sector

Verditek not subject to the pricing pressure of the large OEMs

Competitive landscape in the solar manufacturing sector

Polysilicon	Wafer	Solar Cell	Solar Module
Daqo		JA Solar	
GCL-Poly		Longi Green Energy	
OCI	Shin-Etsu	Canadian Solar	
Wacker Chemie	Siltronic	Jinko Solar	
Xinte		Motech	
		Q Cells	
		Trina Solar	
		UREC	
			Soltech
			SunPower
			Vivint Solar

Source: SEAL Advisors

Verditek is only active in solar modules manufacturing, using cells sourced from OEMs located in Taiwan. The Verditek production process is ‘cell-agnostic’, which means that they are not tied to any one particular design of cell, meaning that they can build in improvements in cell technology as they occur by switching to the newest generation of cells. A key virtue of the market niches targeted by Verditek is the fact that not only are their requirements unsuited to the heavier conventional panels produced by the global solar OEMs, but the average order sizes are also typically much lower. This lowers the risk that Verditek finds itself competing against companies that are able to significantly undercut it on price as a result of manufacturing scale advantages. Verditek’s main direct competitors in the module segment include some of the smaller Chinese manufacturers (such as SunMan with its lightweight ‘eArche’ panel) and small European manufacturers such as Solbian and Soltech.



❖ Long-run revenue scenario for Verditek Solar

In constructing a long-run revenue scenario analysis for Verditek, the key factors to consider are possible demand for the company's products as well as its ability to supply that demand from available manufacturing capacity. Currently, Verditek has two production lines operating at its manufacturing facility in Lainate, near Milan. These lines have a combined effective name plate capacity of 60 MW pa (allowing for recent productivity advances in panel technology plus assuming triple-shift working). Assuming a max peak utilisation rate in the high 80% would equate to an effective max capacity of c.52 MW pa. This gives the unit volume part of the revenue equation based on the current manufacturing footprint. In terms of the price component, the company estimates that the (current) selling price is in a range of EUR1.0-1.5m/MW, depending on the customer and application.

Orders signed to date represent around 2.5MW, equivalent to only c.4% utilisation of effective capacity, the company therefore has ample spare capacity (at present) to capitalise on the large TAMs that it is targeting. The long-term scenario assumes that further contracts are won across the various verticals such that maximum effective capacity in the Lainate facility is reached in Year 4 (run-rate). However, prior to this, the scenario assumes that the company opens an additional manufacturing facility to meet future demand, most likely slightly larger than its current facility (perhaps c.100 MW nameplate capacity) and possibly located in Asia which would put it closer to end customers as well as introduce geographical diversity into the manufacturing footprint (likely capex bill c.£5m). The revenue scenario depicted below assumes this new plant goes operational in year 4 (which accounts for the drop in the overall utilisation rate shown in that year). Price per MW is assumed to deflate at 7% pa.

Scenario analysis	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Name-plate Capacity (MW)	60	60	60	160	160	160	160
Capacity utilisation rate (%)	5.0%	25.0%	65.0%	38.9%	51.4%	67.0%	79.5%
Volume sold (MW)	3	15	39	62	82	107	127
Price/MW (Eur)	1.23	1.14	1.06	0.99	0.92	0.86	0.80
GBE/EUR exchange rate	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Price/MW (£m)	1.12	1.04	0.97	0.90	0.84	0.78	0.72
Revenue (£m)	3	16	38	56	69	83	92
Utilisation assumptions	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Current facility (Lainate):							
Name-plate Capacity (MW)	60	60	60	60	60	60	60
Volume sold (MW)	3	15	39	52	52	52	52
Capacity utilisation rate (%)	5%	25%	65%	87%	87%	87%	87%
New facility:							
Name-plate Capacity (MW)	n/a	n/a	n/a	100	100	100	100
Volume sold (MW)	n/a	n/a	n/a	10	30	55	75
Capacity utilisation rate (%)	n/a	n/a	n/a	10%	30%	55%	75%

Verditek's implied market share on a SAM basis in the final year of the above model would be c.3%.

Clearly, the long-term revenue scenario outlined in the table above is highly dependent on a number of key assumptions, notably the rate at which Verditek is able to win new orders to deliver the increases in capacity utilisation rate, production and sales. Additionally the investment in a second plant is of contingent on the company filling existing capacity at the rate shown in the table. As such, the above should not be taken as a forecast, but rather a long-term revenue scenario that depicts what could transpire under a certain set of assumptions. The actual outturn may differ markedly from that detailed in the scenario described here.



Sources of optionality

❖ Graphene-integrated solar PV cells

The long-run revenue scenario we have outlined for solar does not include any impact from Verditek's JDP with [Paragraf](#) and the commercialisation of its graphene-integrated solar cell (GIPV). Currently the technology is not proven from a commercial mass-market perspective, but also the business model for a GIPV would differ from the in-house manufacturing model adopted by Verditek for its lightweight solar PV products. Were the JDP to result in a commercially successful solar cell, Verditek would likely seek to licence out the technology, rather than produce the cells in-house. The royalty route being the most effective means of targeting the potentially very large TAM available for GIPV solar cells. In the event that this product can be effectively commercialised and produced on a mass-market basis, the implications for Verditek could be substantial.

The likely customers/potential royalty partners for the Paragraf-Verditek GIPV would be the global Consumer Electronics OEMs, particularly those operating in the broad area of mobile internet-enabled devices (handsets/tablets/OEMs). Here the value added of the graphene-based product would be to meaningfully extend battery life without adding significant weight to the device. With annual smartphone sales of c.1.5bn units globally, tablet sales of c.150m units pa and a similar number of laptops sold every year, the TAM could be potentially very large. In this respect, comparatively small penetration rates could have a meaningful impact on company revenues.

❖ Carbon-capture and bio-filtration

In addition to its investments in solar, Verditek currently has two further sources of optionality within the clean-tech sector. These are a 23.6% equity stake in [ICSI](#), which owns a novel patented absorption technology that optimises mass transfer of gas and liquid with applications in industrial emissions control and carbon capture; and its 51% stake in BBR Filtration, which owns a patented bio-filtration de-odourisation technology with applications in the utilities and industrial sectors.

While the technology looks extremely interesting, particularly the carbon capture technology, neither ICSI or BBR Filtration have yet to achieve sales. However, the addressable markets for both are large. For IC Solutions, the sour gas market alone (treatment of natural gas to meet sales gas requirements) is worth c.USD55bn pa, and to this should be added the opportunity in carbon capture, with the global carbon capture and sequestration market size estimated at c.USD5bn pa (2017A) and growing at c.15% CAGR (source: ResearchandMarkets). For BBR, annual capex spend on abatement technology is c.£450-600m pa. If IC Solutions or BBR are successful in even targeting a small proportion of their respective end markets, this could have significant implications for the value of Verditek's equity stakes in these companies. As such, this represents a further source of optionality for Verditek.

In summary

Verditek is a unique company listed on the London stock exchange. It offers a direct exposure to the fast growing solar module market with a particular focus on off-grid applications. It has recently moved from the development and production phase to one of commercialisation. Its production facility is fully operational and its addressable markets are very large. Delivery and execution of orders is now the key to its success.

Revenue scenario for solar does not include any contribution from graphene

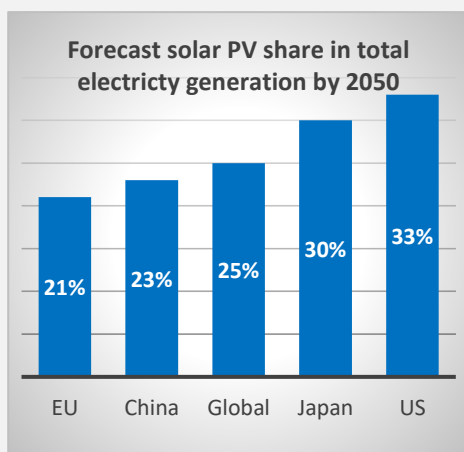
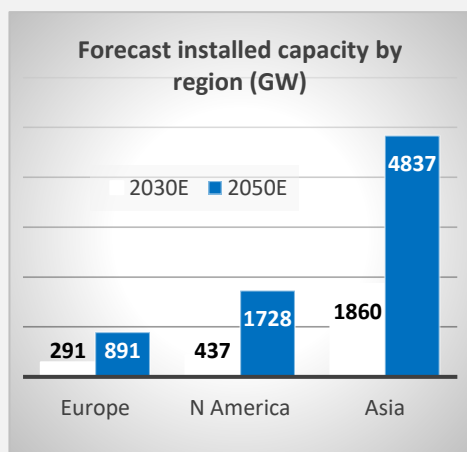
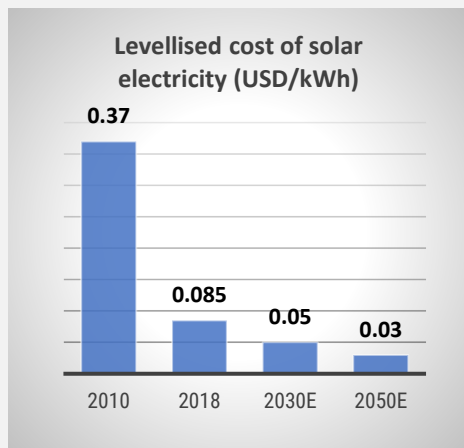
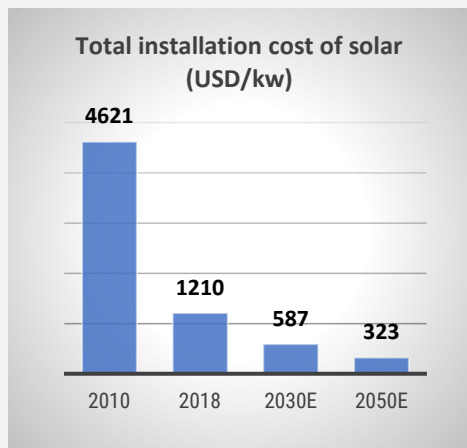
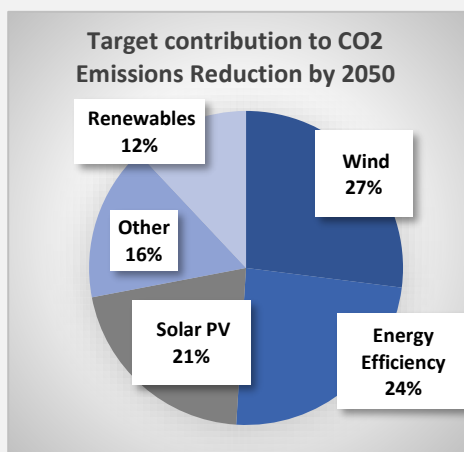
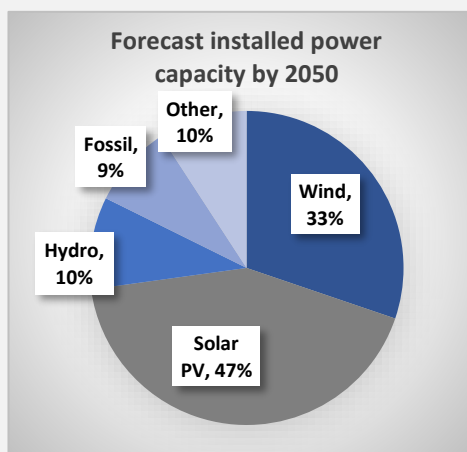
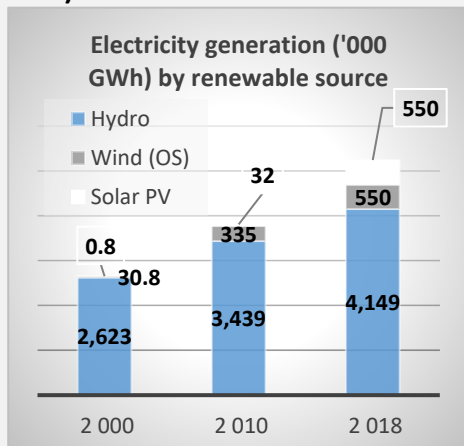
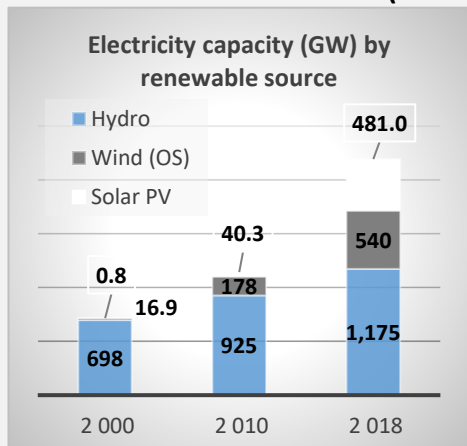
Potential market for graphene-based solar PV cells is substantial

Other sources of optionality include bio-filtration and carbon capture

Carbon capture market is very large and growing by over 15% per year



❖ Solar market: The Outlook (IRENA 2019)



A short history of solar power

1839	Edmond Becquerel discovers the photovoltaic effect
1883	US inventor Charles Fritts builds world's first solar cell
1884	World's first rooftop solar panel is installed in New York
1905	Einstein publishes a paper on the photoelectric effect
1941	First silicon monocrystalline cell is created
1954	Bell Labs create world's first commercial silicon solar cell
1958	Solar energy helps power NASA's Vanguard 1 satellite
1960	Hoffman Electric achieves 14% efficiency in PV cells
1963	Mass production of solar PV cells begins
1976	First amorphous silicon PV cells developed
1977	Average price of solar cell is c.USD77/Watt
1982	First solar power station >1MW is built in California
1985	Uni of Nw Sth Wales achieves 20% efficiency for silicon cells
1986	ARCO manufactures first thin-film solar panel
1992	Uni. of Sth Florida develops a 15.9% efficient thin-film cell
2012	World's cumulative PV electricity capacity > 100GW
2014	Ivanpah, solar power generation plant goes online
2015	Sun Power achieves 22.8% efficiency
2016	First solar-powered plane flight around the world
2018	Oxford PV perovskite solar cell achieves 28% efficiency
2019	Global installed solar capacity 580GW
2020	Average price of solar cell is c.USD0.80/Watt



Financial Summary (reported)

Summary Income statement

End December (£m)	2017(FY)	2018 (FY)	2019 (FY)	2020 (H1)
Revenue(m)	0.00	0.00	0.00	0.00
EBITDA	-1.81	-1.91	-1.59	-0.80
EBIT (m)	-1.81	-1.92	-1.66	-0.84
PBT (m)	-1.98	-2.66	-1.86	-0.92
EPS (p) – fully diluted	-0.01	-0.01	-0.01	-0.00
DPS (p)	0.00	0.00	0.00	0.00

First revenues expected in H2 2020

Summary Balance sheet

End December (£)	2017(FY)	2018 (FY)	2019 (FY)	2020 (H1)
Non-current assets	1.03	0.52	0.91	0.93
Current assets	1.90	1.12	0.58	1.12
Cash	1.19	0.68	0.11	0.59
Total Assets	2.93	1.64	1.49	2.05
Current liabilities	0.40	0.58	1.67	1.51
Long term liabilities	0.00	1.17	0.19	0.18
Total liabilities	0.40	1.75	1.85	1.68
Total interest bearing debt	0.11	1.21	0.67	0.70
Net Assets	2.53	-0.11	-0.37	0.36

Cash of £0.59m at H1 2020. £0.3m received post period end

Total interest bearing debt includes £0.17k of convertible loans

Summary Cashflow statement

End December (£)	2017(FY)	2018 (FY)	2019 (FY)	2020 (H1)
Operating cashflow	-1.61	-1.71	-1.32	-0.94
Interest	-0.01	0.00	0.00	0.00
Tax	0.00	0.00	0.00	0.00
Capex (gross)	-0.08	-0.14	-0.16	-0.00
Acquisitions (net)	-0.74	0.00	0.00	0.00
Dividends	0.00	0.00	0.00	0.00
Other	3.61	1.33	0.91	1.42
Net cash flow	1.17	-0.52	-0.58	0.48
Opening net debt/cash	-1.09	0.53	0.56	0.11

Manufacturing site in Italy now fully invested

Net debt of £0.11m at H1 2020

H1 2020 figures are unaudited



Board of Directors

Lord David Willetts Chairman

Member of Parliament for Havant (1992-2015), Minister for Universities and Science (2010-2014). Lord Willetts is a visiting Professor at King's College London, Governor of the Ditchley Foundation, Chair of the British Science Association and a member of the Council of the Institute for Fiscal Studies.

George Kataros Non-Executive Director

George is the founder of Verditek plc. George has over 30 years' experience in advisory and asset management as well as investment banking and venture capital particularly for cleantech companies. George is a co-founder of Zerowatt Homes International Limited, a modular construction company.

Rob Richards Chief Executive Officer

Experienced Asia Pacific COO / Executive Director / Regional Director within the oil & energy sector. Skilled in delivering large EPC projects and running multi-discipline projects. Bachelor of Engineering (BEng) (Hons) in Electrical Power Engineering from Heriot-Watt University and a Chartered Engineer.

Gavin Mayhew Non-Executive Director

Gavin was formerly the CEO of Energy Savers FZE, a UAE consultancy providing energy saving solutions to commercial and industrial clients. Before that Gavin was president of Zubair Terminal Company in Iraq, which was setup to finance, develop and operate a new commercial port in Iraq.

Key Events

Date	Event
Aug-17	IPO/Admission to AIM, raised £2.75m
Aug-17	Trial contract with Media One to power outdoor billboards
Apr-18	Lord Willetts appointed as Non-Executive Chairman
June-18	Successful First Stage CO2 Capture Test for WES
Oct-18	Stake in WES transfers to stake in ICSI
May -19	Verditek takes complete control of Greenflex Energy
May-19	Official opening of PV module factory in Lainate Italy.
Jun-19	JDP announced with Paragraf for graphene integrated PV to produce world's first GIPV
July-19	Passes IEC Certification of solar PV Technology
May-20	Rob Richards appointed as CEO
June-20	First order in the oil & gas sector
Jul-20	First commercial order in the mining sector
Aug-20	Significant follow-on order from SAF
Sept-20	First commercial order in the Australian mining sector

Listed peer group (international)

*12/10/2020

Company	Country (HQ)	Ticker	Market Cap*
Canadian Solar	Canada	CSIQ	USD2.2bn
First Solar	US	FSLR	USD8.4bn
Jinko Solar	China	JKS	USD2.6bn
Soltech	Sweden	SOLT	SEK1.4bn
SunPower Corp	US	SPWR	USD2.8bn
SunRun	US	RUN	USD12.5bn
Vivint Solar	US	VSLR	USD5.4bn
Verditek	UK	VDTK	GBP33m

Verditek – the future of solar



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Glossary of terms used in this report

CAGR	Compound annual growth rate
GIPV	Graphene-integrated photovoltaic cell
GW	Gigawatt of power
JDP	Joint development program
KW	Kilowatt of power
MW	Megawatt of power
Nameplate capacity	The full-load sustained output of a facility (e.g. solar module production facility)
OEM	Original equipment manufacturer
PV	Photovoltaics - the conversion of sunlight into electricity using semiconducting materials that exhibit the photovoltaic effect
SAM	Serviceable addressable market
TAM	Total addressable market

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