Ceres Power Holdings

A change of power

Initiation of coverage

Alternative energy

Ceres Power has developed a next generation fuel cell technology, which can be manufactured cost-effectively using standard processes and inexpensive materials, thus bringing down costs and enabling widespread adoption. Ceres is engaging with partners in Japan, Korea and the US to embed its technology in low-power distributed power generation applications for use in domestic and commercial environments.

Year end	Revenue (£m)	EBITDA* (£m)	PBT* (£m)	EPS* (p)	DPS (p)	P/E (x)
06/14	1.2	(6.7)	(7.7)	(1.2)	0.0	N/A
06/15e	0.4	(9.6)	(10.7)	(1.2)	0.0	N/A
06/16e	1.0	(11.2)	(12.4)	(1.4)	0.0	N/A
06/17e	2.0	(10.8)	(12.0)	(1.4)	0.0	N/A

Note: *EBITDA, PBT and EPS are normalised, excluding intangible amortisation, exceptional items and share-based payments.

Ceres's technology offers a route to economically viable fuel cell-based systems for mass deployment

Distributed power generation systems based on fuel cells enable an ideal solution that generates electricity more efficiently than the grid, reduces overall energy consumption and provides increased security of supply for homes and businesses, while at a national level reduces the significant investment required in replacing ageing centralised power generation infrastructure. However, while the technology is proven, adoption remains limited because existing systems are not yet cost-competitive. Ceres's patented Steel Cell technology is an innovative solution to the cost problem, predicated on using non-exotic materials that can be processed in volumes using conventional manufacturing equipment and techniques. Its initial target market is domestic combined heat power (CHP) systems, where the additional efficiency from providing hot water and heating further improves the economic case.

Blue-chip partners to take product to market

Ceres's Steel Cell technology is proven to deliver high electrical efficiency and robustness at fuel cell stack level. Ceres is engaging with partners in Japan, Korea and the US that will integrate the Steel Cell stack into complete power generation systems. We model a growth in revenues arising from greater customer engagement, but exclude any fees from royalties or licensing when products incorporating the technology are commercialised. Management expects the July 2014 placing to provide funding well into FY16.

Valuation: Long-term value from royalties

The long-term value for Ceres lies in potential royalty streams created when energy generation systems incorporating Steel Cell technology are commercialised. For illustration, we estimate that, if commercialisation is successful, a 40% share of the Japanese CHP market and deployment in 20% of all boilers sold in Korea could generate c £130m annual royalty revenues. A 5% share in the EU or US boiler markets could add c £60m or c £80m royalty revenues respectively.

22 June 2015

Price	**9.58p**
Market cap	**£74m**

Net cash (£m) at end December 2014	22.7
Shares in issue	772.5m
Free float	51.5%
Code	CWR
Primary exchange	AIM
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	1.9	10.1	(0.8)
Rel (local)	5.8	13.0	(1.7)
52-week high/low		10.88p	6.65p

Business description

Ceres Power is a developer of low-cost, next-generation fuel cell technology for use in decentralised energy products that reduce operating costs, lower CO_2 emissions, increase efficiency and improve energy security.

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Prelims	September 2015

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Edison profile page

Ceres Power Holdings is a research client of Edison Investment Research Limited

Investment summary: Making fuel cells affordable

Company description: Low-cost, robust fuel cell technology

Ceres' patented Steel Cell technology for fuel cells operates on mains natural gas, is robust and offers high energy conversion efficiency. Importantly it is manufactured using standard processes and conventional materials such as ferritic steel, which means it can be mass produced at an affordable price for domestic and business use. Following the adoption of a new business model in 2013, Ceres now develops only the fuel cells and stacks that selected partners integrate into their power generation systems enabling it to access multiple geographies under the aegis of well-recognised brands. Ceres is currently working with industry partners in Korea and Japan to develop domestic CHP systems using Steel Cell technology and with an industry partner in the US to investigate the development of higher power electricity generation systems for use as prime power and back-up power for homes, commercial premises and data centres. Management states that the electrical efficiency of the Steel Cell technology is already superior to commercially available technology in the key Japanese market. Ceres continues to improve electrical conversion efficiency, power density, stack lifetime and manufacturing techniques so that systems incorporating the Steel Cell technology will become cost-competitive with conventional technology without subsidies.

Financials: Extending customer engagement

Our financial model assumes a ramp-up in revenues as existing customers mature from initial technology evaluations to joint development programmes and additional customers engage in technology evaluations. The goal is for established customers to pay an up-front licence fee and royalties once their products incorporating the Steel Cell technology are commercialised. We exclude any potential licence and royalty fees from our financial model, giving substantial upside to our estimates. Net cash at end H115 benefited from the placing in July, which raised £19.6m (net) at 8.5p/share. This provides the balance sheet strength to engage with commercial partners for the next stages of joint development and commercialisation. Management expects this placing to provide funding well into FY16. In the absence of any one-off licence payments, our estimates show a £4.3m funding gap in FY17, which we model as being satisfied through debt.

Valuation: Long-term value from potential royalty streams

Although Ceres has yet to generate commercial revenues, long-term value resides in the potential royalty streams generated when energy generation systems incorporating Steel Cell technology are commercialised. For illustration, we estimate that a 40% share of the Japanese CHP market, achieved in conjunction with the existing Japanese partner, and deployment in 20% of all boilers sold in Korea through working with partners, could give rise to annual royalty revenues of c £130m. A 5% share in the EU boiler market or the larger US market could generate a further c £60m or c £80m of annual royalty revenues respectively. Since it is not possible at this point to determine the potential dilutive impact of any financing activity, we are not attempting to derive an indicative share price from this analysis. The analysis assumes that technological advances enable Ceres and its partners to achieve the target selling prices required to be cost-competitive.

Sensitivities: Further scaling up of manufacturing

The Steel Cell technology exhibits sufficiently high electrical conversion efficiency and lifetime requirements for commercial adoption, but development work is ongoing to further scale some manufacturing steps so that systems deploying the technology are competitive without recourse to subsidies. The strategy of working with partners to develop complete systems means that Ceres is dependent on those partners taking product to market. The drop in global crude prices has widened the gap between electricity and gas prices, improving the economic payback for fuel cells.

Company description: Affordable fuel cell technology

Ceres Power was established in 2001 to acquire fuel cell intellectual property rights developed over the preceding decade by Imperial College, London. It was admitted to AIM in 2004.

The original research programme was aimed at determining whether it was possible to create a fuel cell from low-cost materials. From this IP Ceres has developed its patented Steel Cell technology for producing third-generation solid oxide fuel cells (SOFCs). The Steel Cell technology is more efficient, significantly lower cost and more robust than other SOFC technology and competing fuel cell technologies. It is applicable to many high-volume applications. Initially Ceres is focusing primarily on the residential sector as well as the commercial and data centre sectors, designing fuel cell stacks with output powers up to 10kW. Management is engaging with major OEMs of domestic and commercial power and heating systems in Japan, Korea and the US that will potentially integrate the Steel Cell technology into their own products. Management expects that this new approach will reduce the time required to reach the commercialisation phase.

Ceres is headquartered in Horsham, England, with an office in Kyoto, Japan. It employs around 100 people. The Horsham facility houses production and test equipment capable of manufacturing fuel cells and stacks in the volumes required to support customer evaluations and development programmes. Ceres intends to partner with third parties that will be able to manufacture in the higher volumes required as customers transition to the commercial phase.

Fuel cell market: Key role in distributed power systems

Power generation is shifting from a centralised to a distributed model in which fuel cell-based generation systems play a key role. There are several drivers behind this:

Energy conversion efficiency: the systems represent a more efficient way of converting the energy in natural gas to electricity. Domestic CHP systems increase the amount of electrical energy generated from each unit of gas in three ways. Firstly, SOFCs are inherently more efficient at converting natural gas to electricity than even advanced natural gas-combined cycle (NGCC) plants (Exhibit 1). Secondly, in the centralised NGCC case around 8% of the initial energy content in the gas is dissipated as the electricity is distributed over the grid to household or business premises. Thirdly, in a CHP system, the heat energy produced as a by-product of the energy conversion process is used to heat up water for washing or central heating, so the total amount of energy converted to useful power is 80-95%, significantly reducing the payback period of the equipment and improving the economic case for adoption. This reduces the amount of carbon dioxide emitted for each kWh of electricity generated, helping governments meet their climate change obligations.

Security of energy supply: the systems reduce dependence on the electricity grid. This is important both in developed countries such as the UK where the infrastructure is ageing and in developing economies where demand is growing faster than supply, causing prolonged blackouts.

Reducing investment required in power generation infrastructure: substantial programmes of investment are required globally to meet increasing energy demands or replace aging infrastructure and it is less expensive and risky for utilities to invest in distributed power generation systems than centralised units. A study carried out by the Department of Energy’s Pacific Northwest National Laboratory published in December 2014 noted that total electricity generation capacity in the US would need to increase by 68GW between 2013 and 2022. This capacity gap is exacerbated by the retirement of coal-fired generation facilities taking out 59-77GW of capacity by 2022. The study concluded that distributed generation based on SOFC technology could play a role in meeting this demand cost-effectively and more quickly than constructing advanced natural gas-combined cycle plants and with less risk to the investor, as capacity may be added as required. The cost-effectiveness depends on being able to construct SOFCs with an extended stack life and in high volumes, which is what Ceres's Steel Cell technology is designed to do.

Exhibit 1: Comparison of costs and benefits of central grid production with distributed generation

	HHV efficiency	CO2 emissions (g/kWh)	NOx emissions (mg/kWh)	SOx emissions (mg/kWh)	Capital cost ($/kW)	Levelised cost of electricity (c/kWh)	Fuel cost ($/MMBtu)	Additional benefit of distributed generation (c/KWh)
1,000MW vintage coal	32%	1,080	3,400	29,000	-	3.8	2.34	-
1,300MW pulverised coal with carbon capture and storage	28%	112	327	109	4,600	13.9	2.34	-
400MW advanced natural gas combined cycle	53%	341	22	3	1,000	6.5	4.5	-
270kW natural gas solid oxide fuel cell	56%	289	<33	0	672	8.2 5.2	8.69* 4.5**	6.18

Source: Pacific Northwest National Laboratory, December 2014. Note: *Gas at retail prices. **Gas at wholesale prices.

This combination of factors is driving market growth. Annual sales of fuel cells for stationary power generation applications, the segment in which Ceres is based, have risen from 35.4MW in 2009 to an estimated 147.3MW in 2014 (source: e4tech: The Fuel Cell Industry Review 2014) and global revenues from the stationary fuel cell sector are expected to rise from $1.8bn in 2013 to $8.5bn by 2020. However, the amount of power generated from fuel cells remains small in comparison with total generation capacity. In 2013 total electricity capacity in the US was 1029 GW, of which fuel cells contributed only 0.1 GW (source: Annual Energy Outlook 2015, US Energy Administration Uptake continues to be held back by the relatively high cost of fuel cell technology. This currently restricts adoption to situations where either the availability of subsidies or the financial cost of being without power changes the economics in favour of fuel cell deployment. Reducing the cost of fuel cells through adopting Ceres's potentially lower-cost technology would accelerate deployment.

Japan and Korea – fuel cells subsidised to reduce gas imports

The Japanese government is keen to promote fuel cell technology as a way of reducing gas imports, which account for an estimated 97% of national energy requirements. This is especially important given the de-emphasis on nuclear power generation after the Fukushima incident. Since 2009 the government has supported the ENE-FARM programme, which encourages the adoption of combined heat and power (CHP) fuel cells for domestic installation through the provision of subsidies that will continue through 2015. Between 2012 and 2014, 81k fuel cell CHP systems, the majority of which were proton exchange membrane (PEM) fuel cells, the remainder SOFC, were installed under the Japanese government's programme. The government goal is for 5.3m residential ENE-FARM units to be operating by 2030. Panasonic and Toshiba currently supply PEM based systems for this project, Aisin Toyota SOFC systems. Ceres intends to address this segment with its joint development partner, one of the leading global Japanese power systems companies. Management notes that Ceres has demonstrated higher efficiencies from its fuel cell prototype systems than those currently delivered by the three market incumbents.

The government of South Korea is also keen to reduce its reliance on gas imports, requiring its largest utilities obtain 10% of their energy from renewables by 2022. In February 2014, a 59MW fuel cell park, then the largest in the world, commenced operation in Hwasung City. These projects typically deploy molten carbonate fuel cell (MCFC) systems from FuelCell Energy, a company in which POSCO, Korea's largest private utility, has an 11% stake. Ceres intends to address the lower-power domestic CHP segment with partner KD Navien, Korea's largest boiler maker. Korean conglomerate Doosan has entered this market by acquiring ClearEdge and Fuel Cell Power.

US – high cost of power outages justifies deployment of fuel cells

Banks, telecommunications network operators, hospitals, educational and penal establishments and waste water treatment sites are increasingly deploying fuel cells as primary or back-up power.

For these applications the economic cost of not having power, estimated by the Lawrence Berkeley National Laboratory in 2009 at $14.4-173.1/kWh for medium and large commercial and industrial facilities, overrides the higher cost of electricity from fuel cellsBloom Energy (SOFC technology) and FuelCell Energy (MCFC technology) are the dominant providers of high-power systems for the larger systems deployed by utilities and industrial users such as data centres. Ceres intends to address the data centre and industrial segments, potentially with partner Cummins Power Generation and is in preliminary discussions with other possible partners (that may include KD Navien, which has a 60% share of the North American market for instantaneous condensing gas water heaters) to address the domestic segment.

EU – fuel cells being adopted to meet CO_2 targets economically

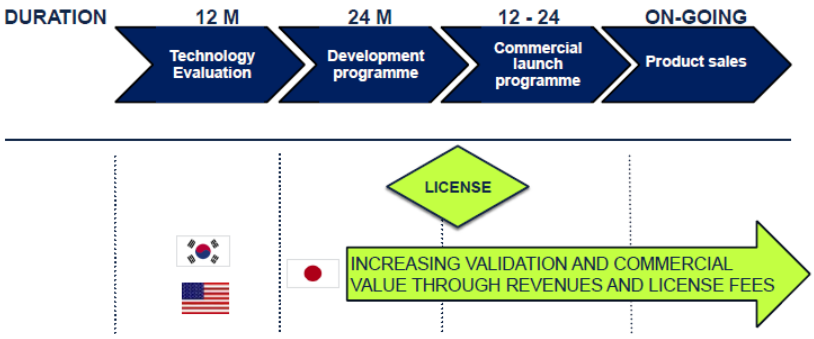
In the EU SOFC generators are being adopted as part of the programme to reduce CO_2 emissions, as they are a highly efficient way of converting natural gas to electricity (see above). They are much better suited than centralised power plants to changes in demand caused by fluctuations in output from renewable sources. Also, surplus electricity generated by wind, wave or solar power can be converted to hydrogen gas, passed into the gas grid for storage and then used to generate electricity when demand exceeds supply. The European Commision's ene.field project targets the deployment of 1,000 PEMFC and SOFC micro-CHP units across 12 member states. European boiler manufacturers are teaming up with suppliers of fuel cell technologies to develop systems for the project. For example German boiler giant Viessmann took a 50% stake in Hexis for its SOFC technology and is in discussions with Panasonic regarding the latter's PEMFC technology. Bosch is using SOFC technology from Aisin Seiki. Vaillant is working with Fraunhofer technology. It is probable that Ceres's partner KD Navien will develop a product for the European market once the commercial opportunity warrants it. This product may then be offered to British Gas, one of Ceres's shareholders.

Strategy: New model accelerates product adoption

Following the appointment of chairman Alan Aubrey in December 2012 and CEO Phil Caldwell in September 2013, the business model has changed. Historically, Ceres intended to commercialise complete end-user products. Now it forms partnerships with industry leaders that will develop and sell complete product, with Ceres licensing the core fuel cell technology. This approach enables Ceres to access multiple geographies under the aegis of well-recognised brands, potentially accelerating product adoption. In parallel management is evaluating potential manufacturing partners that will be able deliver commercial volumes of fuel cells and stacks.

Monetising the technology through partnerships

Exhibit 2: Typical OEM engagement process



Source: Ceres Power

Ceres Power follows a phased programme of engagement with potential customers, which begins with an evaluation of the technology, during which time Ceres receives a fee from the third party for the supply of fuel cell modules or systems and associated engineering support. Once successful, this progresses to a joint development programme under which Ceres receives higher levels of payment for sharing its IP with the partner. When the partner launches a product incorporating the technology Ceres will receive an up-front licence fee plus follow-on royalty payments based on the volumes sold. While not all the partnerships can be expected to go through to commercialisation, success with a relatively small number of companies would give Ceres a significant market share.

Commercialisation status

Japan: following a year-long evaluation of the Steel Cell technology, which concentrated on performance, robustness and ability to handle repeated power cycles, in October 2014 Ceres Power signed a Joint Development Agreement with one of the leading global Japanese power systems companies. Under the agreement the companies will jointly develop a fuel cell stack using the Steel Cell technology, to be built in the UK and then tested in Japan for its application in both residential and generator systems of 1-5kW. The first results from the development programme have met the initial performance targets and the two companies are currently discussing further stages in extending the relationship further. Japan is a key market. Ceres has developed a strong commercial pipeline in the country and expects several more companies to enter evaluation stages in the coming months.

Korea: in January 2014 Ceres shipped the first fuel cell power system to KD Navien under the terms of the technology assessment agreement. This was the first deployment outside the UK. The system has successfully demonstrated superior performance for cycling and robustness compared to similar SOFC technologies. Management is currently discussing the second phase of the development programme under which the two partners will jointly develop a 1kW product for the Korean and international markets based on the Steel Cell technology.

US: in March 2014 Ceres signed a Joint Development Agreement with Cummins Power Generation to explore the joint development and commercialisation of the Steel Cell technology for products in Cummins's existing market data centre and back-up power markets with output powers of 10kW and above. This programme is ongoing.

Improving the technology

Performance: Ceres aims to achieve over 50% net electrical efficiency over the next two years as this level is required for commercial applications. During H115 Ceres demonstrated 47% net electrical efficiency in a prototype CHP product. Management states this is equivalent to the highest performance achieved for SOFCs in Japan and is superior to the existing PEM products.

Robustness: Ceres has successfully demonstrated the ability of the Steel Cell technology to turn on and off over 600 times (equivalent to at least 30 years' usage) with almost no loss or performance. When operated under steady-state conditions it consistently achieves degradation rates equivalent to a 5-7 year life, the entry level requirement for good economic payback.

Cost: Ceres aims to double power density by 2020 and is on track to achieve this target. During H115 it demonstrated a 40% improvement, potentially giving a 40% reduction in stack cost and around a 20% reduction in overall system cost. The modifications will be deployed on customer programmes later this year. It is also looking at optimising processes for volume. For example it is partnering with ASM Assembly Systems, a global provider of screen printing equipment, supported by £0.7m grant funding from Innovate UK. The programme aims to use high-speed photovoltaic printing machines for some processes in order to improve volume throughput and reduce processing time and costs.

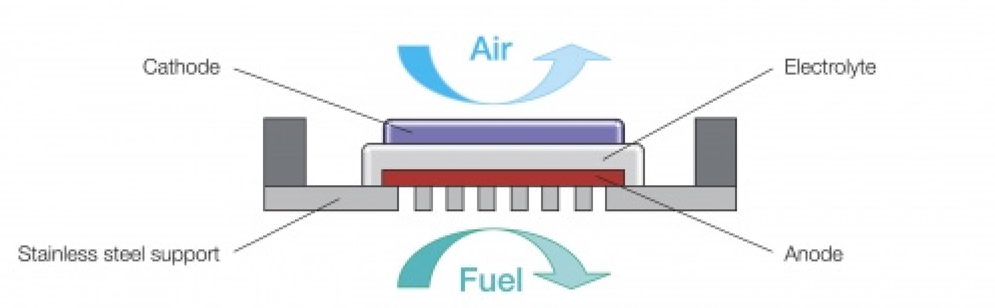
Scaling business

During FY15 Ceres will develop its manufacturing processes to increase capacity, initially in the UK. The present configuration will support output of 15-20,000 units per year. This could be raised to 40-125k/annum with relatively small levels of investment. This is sufficient for supporting evaluations, joint development programmes and early stages of product launches. Some potential customers have the metal processing or ceramic processing capability required to manufacture their own fuel cell stacks, others are likely to outsource manufacture. Ceres is actively engaged with manufacturing partners to look at the potential production of the Steel Cell technology in Asia.

Technology: Innovative solid oxide fuel cell technology

In a solid oxide fuel cell, the anode and cathode are separated by a solid electrolyte. Hydrogen atoms enter a fuel cell at the anode and are stripped of their electrons. These pass through the external interconnect to the cathode, creating an electrical current. Oxygen from the air picks up these electrons at the cathode and passes through the electrolyte to the anode where it combines with the hydrogen ions to create water and heat energy.

Exhibit 3: Ceres Steel Cell structure



Source: Ceres Power

Fuel cells bring about a controlled reaction between hydrogen and oxygen to form water, electrical energy and heat energy. Since hydrogen and oxygen do not spontaneously react, the electro-chemical reaction is effected either by bringing them together in the presence of an expensive catalyst such as platinum or heating the gases to a high temperature. PEMFCs are the most widely deployed at present because this is a mature technology that operates at relatively low temperatures. The drawback is that the technology relies on platinum, pushing up costs. SOFC, which is Ceres's technology, is gaining in popularity because it offers potentially higher levels of electrical efficiency and does not require a costly platinum catalyst. However, SOFCs depend on high temperatures to get the reaction going. The higher the temperature, the more exotic and more expensive the fuel cell materials become. The evolution of SOFC cells, which is discussed later, can be viewed as a quest to find electrolyte materials and structures that operate at lower temperatures, enabling the entire fuel cell to be made from less expensive materials.

The other drawback with PEM systems is that they typically run off pure hydrogen gas, which is not readily available. They can be adapted to run off natural gas, which is readily available through national grid networks, by adding a complex external reformer to the fuel cell system that adds significant cost to the completed product. SOFC systems typically run off natural gas, using a simpler, less expensive type of external reformer.

Crucially for applications in the domestic or commercial environment, SOFC exhaust streams are sufficiently hot to heat water for washing purposes or for space heating in a CHP system. This raises the overall energy conversion of the system from over 40% to between 80% and 95%. We note that the two market segments in which Ceres is making most progress are the provision of

CHP systems in Japan and Korea, as the additional efficiency offered by using the heat generated improves the total cost-effectiveness.

Exhibit 4: Comparison of fuel cell types

Fuel cell type	000s of units shipped*	MW shipped*	Platinum catalyst	Operating temperature	Electrical efficiency	Applications	Companies
Proton exchange membrane fuel cell (PEMFC)	65.3	69.7	✓	80°C	40-60% hydrogen fuel, c 35% natural gas	Transport, portable, stationary residential and commercial/industrial.	Ballard, Heliocentris, Hydrogenics, Intelligent Energy, ITM Power, Plug Power, Doosan
Solid oxide fuel cell (SOFC)	1.8	32.3		550-1,000°C	45-60%	Stationary utilities, commercial/industrial and residential, auxiliary power units, portable military.	Aisin Seiki, Bloom, Ceres Power, GE, Hexis (also see Exhibit 5)
Direct methanol fuel cell (DMFC)	3.1	0.2	✓	50-120°C	<40%	Portable consumer/military, auxiliary power units.	SFC Energy
Alkaline fuel cell (AFC)	0.0	0.0		90-100°C	60-70%	Stationary industrial	AFC Energy
Phosphoric acid fuel cell (PAFC)	0.0**	3.8	✓	100-250°C	36-42%	Stationary utilities, commercial/industrial, auxiliary power units.	Doosan
Molten carbonate fuel cell (MCFC)	0.0**	70.0		600-700°C	50-60%	Stationary utilities, commercial/industrial.	FuelCell Energy

Source: Fuel Cells 2000, LG Fuel Cell Systems, Edison Investment Research. Note: *2014 estimates; **PAFC and MCFC systems are very high-output power, so small numbers of units shipped equate to high generation capacities.

Evolution of the Steel Cell SOFC

We noted earlier that the evolution of SOFCs forms a quest to find electrolyte materials and structures that operate at lower temperatures, enabling the entire fuel cell to be made out of less expensive materials. The first generation, developed in the 1980s and 1990s, uses a thick layer of yttrium-stabilised zirconia as the electrolyte, which also serves as the support for the entire cell. The electrolyte needs to be heated up to almost 1,000°C to become sufficiently conductive, so the rest of the components must be made from expensive and exotic ceramic materials to withstand the high temperature. As they are made entirely from ceramic materials, the fuel cell stacks are delicate and liable to crack when exposed to thermal stress when turned on and off. Second-generation cells have much thinner electrolyte layers. This allows the cell to operate at lower temperatures (650-850°C), so that the interconnect can be made from high-quality steel rather than exotic ceramics, substantially reducing cost. However, there are still issues with robustness because the anode has to be made thicker to give mechanical support to the cell and is prone to cracking.

Exhibit 5: SOFC evolution

	First generation	Second generation	Third generation
	Electrolyte-supported cells	Anode-supported cells	Metal-supported cells
Operating temperature	900-1,000°C	650-850°C	550°C
Maturity of technology	✓✓✓	✓✓	✓
Fuel cell stack cost		✓✓	✓✓✓
System cost		✓	✓✓✓
Robustness	✓	✓	✓✓✓
	Bloom, Fraunhofer (Vaillant), Siemens, Staxera, Westinghouse	Acumentrics, Ceramic Fuel Cells, Delphi, Hexis (Viessmann), Kyocera/Aisin Seiki (Bosch, JX Nippon, Toyota), LG, Redox, Solid Power (Danfoss), Sumitomo, Versa (FuelCell Energy)	Ceres Power Steel Cell technology, GE

Source: Ceres Power, Edison Investment Research. Note: ✓ = OK, ✓✓ = good, ✓✓✓ = excellent.

Ceres Power addresses the problems of cost, robustness and performance by using a thin layer of cerium oxide doped with gadolinium as the electrolyte. This material is conductive at 550°C, so it can be used in conjunction with the relatively inexpensive ferritic stainless steel that is commonly used for car exhausts. A sandwich of thin layers of conducting ceramic (cathode), ceria (electrolyte) and a ceramic-metal mixture (anode) is deposited on a thin steel plate to make a single cell. The steel acts as a support, so the anode can be made thin enough to reduce cracking. The manufacturing process is inherently simpler, less expensive and suitable for high-volume production since it uses printing techniques developed for high-volume production of photovoltaic cells. The technology is protected by 39 patents, which cover core technology areas including anode and electrolyte materials and structure, Steel Cell design, certain manufacturing techniques such as the use of lasers to perforate the steel interconnect with thousands of tiny holes to admit the reactant gases, and stack and system design and operation.

Market consolidation and new entrants

The fuel cell market is dynamic, with global majors taking strategic positions in the sector. Looking only at activity in the SOFC segment, Versa Power was acquired by FuelCell Energy in December 2012 and in June 2012 LG acquired a 51% stake in Rolls-Royce's fuel cell unit. Ceramic Fuel Cells went into voluntary liquidation in March 2015. New entrants are being attracted to the market. For example, SiEnergy Systems, a spin-out of technology from Harvard University, is developing 0.1-5kW stationary power sources for distributed generation applications and GE, which is the only other company with third-generation technology, has recently begun to build a pilot development and manufacturing facility near New York to manufacture SOFCs.

Sensitivities: Affordability is key to market adoption

Technology risk: Ceres has demonstrated that its Steel Cell technology is sufficiently robust. It still needs to improve efficiency, so that it can address the data centre market in addition to the CHP segment and needs to work on both improving power density and scaling production techniques to reduce unit costs so that the technology is competitive without recourse to subsidies.

Government subsidies: at present most fuel cell activity, whether in Japan, Korea, the US or the EU, is supported by government subsidies. These are intended to encourage customer adoption and research in technology and manufacturing techniques to creating volume production at competitive prices without the need for further subsidy. The subsidies will not remain in place indefinitely and may be removed if economic conditions weaken, so standalone economic viability must be proven.

Reliance on channel partners: the strategy of working with partners to develop complete systems means that Ceres is dependent on those partners taking product to market.

Fuel price: the recent drop in global crude prices has resulted in natural gas prices also falling. In most regions this has widened the gap between electricity and gas prices, improving the economic payback for fuel cells.

Valuation: Analysis of future royalty streams

Ceres has yet to generate commercial revenues, so its value resides in the potential royalty streams generated once distributed power systems incorporating Steel Cell technology are eventually commercialised. Announcements about new and existing partners progressing through the engagement process set out in Exhibit 2 are catalysts to crystallise shareholder value. In Exhibit 6 we present a scenario analysis exploring potential royalty revenues and profit generated in each of the three key markets as commercial partners take significant share in their respective markets. Although it is likely that Ceres will adopt a business model in which some of the potential royalties related to single customer engagement are paid up-front as a one-off licence fee, with the payment offset against lower royalty rates, for simplicity our analysis assumes a royalty rate of 7.5% of customer sales, but no up-front licence fees. For the earnings calculation we apply 7.5% cost of sales, 20% tax and model a base level of operating costs at FY17e levels (£14.0m) split equally between activities in Japan and Korea. Since it is not possible at this stage to determine the potential dilutive impact of any financing activity, we are not attempting to derive an indicative share price from this analysis.

Exhibit 6: Scenario analysis showing potential profits attributable to key markets

Japan					
Total number of fuel cell-based CHP systems sold pa 2020-30 : 400,000 (government target)					
Average selling price per unit with Steel Cell technology: ¥654,000 (government target)					
Market share for products with Steel Cell technology	10%	20%	30%	40%	50%
Royalty revenues	£11.0m	£22.0m	£33.0m	£44.0m	£55.0m
Annual profit after tax	£2.5m	£7.5m	£12.5m	£17.5m	£22.5m
Korea					
Total number of domestic boilers sold pa: 1,500,000					
Average selling price per unit with Steel Cell technology: $5,500 (as per Japan)					
Market share for products with Steel Cell technology	4%	8%	12%	16%	20%
Royalty revenues	£16.5m	£33.0m	£49.5m	£66.0m	£82.5m
Annual profit after tax	£6.6m	£14.1m	£21.6m	£29.1m	£36.6m
US					
Total number of domestic boilers sold pa: 7,000,000					
Average selling price per unit with Steel Cell technology: $4,500 (target price required to be competitive with conventional technology)					
Market share for products with Steel Cell technology	1%	2%	3%	4%	5%
Royalty revenues	£15.8m	£31.5m	£47.3m	£63.0m	£78.8m
Incremental PAT pa	£10.4m	£20.8m	£31.2m	£41.6m	£52.0m
EU					
Total number of domestic boiler sold pa: 5,000,000					
Average selling price per unit with Steel Cell technology: €4,140 (target price required to be competitive with conventional technology)					
Market share for products with Steel Cell technology	1%	2%	3%	4%	5%
Royalty revenues	£11.3m	£22.5m	£33.8m	£45.0m	£56.3m
Annual profit after tax	£7.4m	£14.9m	$22.3m	£29.7m	£37.1m

Source: Edison Investment Research. Note: $1.5/£; $/¥119.0; €1.38/£.

Financials: Progressing to commercialisation

Earnings

After stripping out deferred income of £0.7m relating to the ending of a legacy product and supply agreement with Bord Gais Eireann, which flattered H114, underlying revenues in H115 were similar to H114 levels at £0.14m. Revenues were lower than management expectations because the conversion of partners in Korea and the US to next-stage development agreements has taken longer than anticipated. Operating costs rose by £0.9m to £5.7m, reflecting the increased number of employees engaged in R&D and initiatives to improve the company's test and manufacturing capability. Operating losses widened by £1.5m to £5.3m.

Our model assumes that engagement with existing partners will intensify during H215 and into FY16 and that discussions with potential partners will mature into evaluations and development programmes as per Exhibit 2, resulting in a strong ramp-up in revenues through the forecast period. We assume that annual revenues from technology evaluations could be £100-200k per partner, which we estimate could scale up to £500-1,000k for a joint development agreement. Delays in progressing individual customer engagements will have a significant impact on revenue development. At this early stage, we exclude any potential licence and royalty fees from our financial model, giving scope for substantial upside. We estimate that a single licence fee could be worth tens of millions of pounds.

Cash flow and balance sheet

H115 cash consumption, excluding financing, totalled £4.5m. This included £0.8m invested in test facilities. Net cash at end H115 benefited from the placing in July, which raised £19.6m (net) at 8.5p/share, rising from £7.7m at end June 2014 to £22.7m. This provides the balance sheet strength to engage with commercial partners for the next stages of joint development and commercialisation of the Steel Cell technology. The placing attracted both new and existing institutional investors and was oversubscribed, demonstrating investor confidence in the proposition. Noting the receipt after the half-year end of £1.1m income tax credit relating to FY14, we model a slightly higher level of tax credit going forward to reflect higher levels of R&D expenditure. We do not capitalise any of this R&D expenditure. Management expects the July 2014 placing to provide funding well into 2016. In the absence of any one-off licence payments, which we treat as upside, our estimates show a £4.3m funding gap in FY17, which we model as satisfied through debt.

Exhibit 7: Financial summary

£'000	2013	2014	2015e	2016e	2017e
Year end 30 June					
PROFIT & LOSS					
Revenue	523	1,224	399	1,000	2,000
EBITDA	(7,937)	(6,663)	(9,586)	(11,219)	(10,762)
Operating Profit (pre amort. of acq intangibles & SBP)	(9,259)	(7,732)	(10,815)	(12,448)	(11,991)
Amortisation of acquired intangibles	0	0	0	0	0
Share-based payments	(414)	(856)	(1,000)	(800)	(800)
Exceptionals	(3,068)	0	0	0	0
Operating Profit	(12,741)	(8,588)	(11,815)	(13,248)	(12,791)
Net Interest	55	73	100	70	0
Profit Before Tax (norm)	(9,204)	(7,659)	(10,715)	(12,378)	(11,991)
Profit Before Tax (FRS 3)	(12,686)	(8,515)	(11,715)	(13,178)	(12,791)
Tax	1,311	1,122	1,400	1,400	1,400
Profit After Tax (norm)	(7,893)	(6,537)	(9,315)	(10,978)	(10,591)
Profit After Tax (FRS 3)	(11,375)	(7,393)	(10,315)	(11,778)	(11,391)
Average Number of Shares Outstanding (m)	292.8	536.8	754.0	772.5	772.5
EPS - normalised (p)	(2.70)	(1.22)	(1.24)	(1.42)	(1.37)
EPS - normalised fully diluted (p)	(2.70)	(1.22)	(1.24)	(1.42)	(1.37)
EPS - FRS 3 (p)	(3.88)	(1.38)	(1.37)	(1.52)	(1.47)
Dividend per share (p)	0.00	0.00	0.00	0.00	0.00
EBITDA Margin (%)	N/A	N/A	N/A	N/A	N/A
Operating Margin (before GW and except.) (%)	N/A	N/A	N/A	N/A	N/A
BALANCE SHEET					
Fixed Assets	2,234	1,715	2,086	2,357	2,628
Intangible Assets	0	0	0	0	0
Tangible Assets	2,234	1,715	2,086	2,357	2,628
Current Assets	16,935	10,084	19,696	8,507	2,427
Stocks	0	0	0	0	0
Debtors	1,498	2,385	1,986	2,070	2,262
Cash	15,437	7,699	17,710	6,436	165
Current Liabilities	(1,350)	(1,385)	(1,397)	(1,456)	(1,738)
Creditors including tax, social security and provisions	(1,350)	(1,385)	(1,397)	(1,456)	(1,738)
Short term borrowings	0	0	0	0	0
Long Term Liabilities	(3,211)	(2,341)	(2,112)	(2,112)	(6,612)
Long term borrowings	0	0	0	0	(4,500)
Other long term liabilities	(3,211)	(2,341)	(2,112)	(2,112)	(2,112)
Net Assets	14,608	8,073	18,273	7,296	(3,295)
CASH FLOW					
Operating Cash Flow	(10,016)	(8,252)	(9,175)	(11,244)	(10,671)
Net Interest	57	75	100	70	0
Tax	2,667	1,000	1,122	1,400	1,400
Capital expenditure	(42)	(520)	(1,600)	(1,500)	(1,500)
Capitalised product development	0	0	0	0	0
Acquisitions/disposals	0	0	0	0	0
Financing	12,593	(41)	19,564	0	0
Dividends	0	0	0	0	0
Net Cash Flow	5,259	(7,738)	10,011	(11,274)	(10,771)
Opening net debt/(cash)	(10,178)	(15,437)	(7,699)	(17,710)	(6,436)
HP finance leases initiated	0	0	0	0	0
Other	0	0	0	0	0
Closing net debt/(cash)	(15,437)	(7,699)	(17,710)	(6,436)	4,335

Source: Company accounts, Edison Investment Research

EDISON

Contact details	Revenue by geography
Viking House Foundry Lane Horsham RH13 5PX UK +44 (0)1403 273463 www.cerespower.com	N/A

Management team

Chairman: Alan Aubrey	Chief Executive Officer: Phil Caldwell
Alan Aubrey is CEO of IP Group, non-executive chairman of AIM-listed Proactis and non-executive director of Oxford Nanopore. From 2008 to 2014, he was a non-executive director of the Department for Business, Innovation & Skills. Previously he was a partner at KPMG, where he specialised in providing advice to fast-growing technology businesses. He became chairman in December 2012.	Phil Caldwell was previously corporate development director at Intelligent Energy, where he secured OEM partners and executed licence deals and joint ventures. Before this he was responsible for business development for the Electrochemical Technology Business in ICI. He joined Ceres as CEO in September 2013.
Chief Financial Officer: Richard Preston	**Chief Technology Officer: Mark Selby**
Richard Preston joined Ceres in 2008 as financial controller and was appointed to the board in February 2013. Previously he held a number of senior roles in business transformation and project finance at Cable & Wireless.	Mark Selby joined Ceres in 2006 and was appointed to the board in 2014. He is responsible for leading all aspects of the strategy and delivery of the Steel Cell technology development. Before joining Ceres he was part of the Control & Electronics department at Ricardo UK.

Principal shareholders	(%)
IP Group	23.2%
Richard Griffiths	22.3%
Lansdown Partners	9.9%
Henderson Group	8.2%
Sarasin	5.3%

Companies named in this report

AFC Energy (AFC:LN); Ballard Power Systems (BLDP:US); Ceramic Fuel Cells (CFU.L); FuelCell Energy (FCEL:US); Heliocentris (H2FA:GR); Hydrogenics (HYGS:US); Intelligent Energy Holdings (IEH.L); ITM Power (ITM.L); Plug Power (PLUG:US); SFC Energy (F3C:GR)