



Theatre of dreams

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What started out as a sabbatical for a newly qualified PhD student has ended up as a life in the theatre.

Dr Ben Todd made the huge leap from academic to theatre handyman in just one small step: 'And I haven't regretted a single day,' he said last week from his headquarters in a little theatre in London's East End – which now has world-class green credentials thanks to Ben's ideas on fuel cells and a series of grants from the Technology Strategy Board.

When Ben finished his PhD on solid oxide fuel cells at [Cambridge University](#) he decided to take a complete break. So he volunteered to help out with odd jobs at the [Arcola Theatre](#), a small Off-Westend theatre company.

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Technology in public

'A theatre is good place to demonstrate technology because it's not life-dependent but it is hugely demanding and also very public.' So instead of going back to engineering as he had planned, Ben devoted his time to technology demonstration projects at the Arcola.



'We did a load of work around low energy. From the beginning we've been interested in driving down carbon emissions. Over the years we have honed our understanding of where big energy savings come from matching the right power generating and power-consuming technologies to make it easy for users to do the right thing. All of our work builds from that principle 'said Ben.

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Those early efforts have grown into [Arcola Energy](#), a company that develops, manufactures and sells low carbon energy solutions based on fuel cells.

It is still based at the theatre, but has also opened a research base at [Imperial College](#) and in 2013 had sales of around £300k. More

THE COMPANY

Arcola Energy is a developer, manufacturer and retailer of fuel cell-based low carbon energy solutions. It operates across a wide range of markets with applications in industry, construction, entertainment, education, automotive and aerospace sectors.

THE PROBLEM

As a small company Arcola Energy does not generate enough excess cash to fund the research needed to make fuel cell technology cost effective across a wide range of applications.



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energy savings come from matching the right power generating and power-consuming technologies to make it easy for users to do the right thing. All of our work builds from that principle - **Dr Ben Todd**

important, it is close to breaking even and not reliant on outside investors. 'For a fuel cell company that is extraordinary.

'Too many fuel cell companies consume a huge amount of capital and then go bankrupt before they manage to get to market,' said Ben.

Key ingredient for success



The Technology Strategy Board is a key ingredient in its success. 'We wouldn't be here without the Technology Strategy Board. You can run a commercial business and generate a bit of surplus cash but it's not enough to fund the kind of research and development we need to do,' he added.

Fuel cells provide energy as a result of converting hydrogen and oxygen in to water. Because they don't use fossil fuels they produce no direct emissions and combined with the right source of hydrogen are seen as a way to meet the UK government's target of reducing greenhouse gas emissions by 80% by 2050. But one of main challenges is creating applications for them that are cost effective enough to be attractive to end users.

Arcola first worked with the Technology Strategy Board in 2009, before Arcola Energy was set up in 2010. It used a £27k grant to develop a portable lighting unit that combined a 150W fuel cell with high efficiency LED technology to be used in theatres and at outdoor events. 'By combining the right lights with the right generator you can deliver significant carbon savings and a good energy solution,' explained Ben.

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Building relationships

Arcola Energy demonstrated the system in the theatre. It sold a few of its Hylight 150 systems and then, with another £25k grant from the Technology Strategy Board,

developed a more powerful system, the Hylight 500. It has also sold some of these units. 'It was a first step. On that we started to build a relationship with **BOC** (which provided the hydrogen cylinders needed to supply the fuel cells) and with **White Light** (a specialist in event lighting) and established our approach - always work with an end-user.'



Developing those products also showed Arcola Energy how it needed to move forward as a company. 'Our success is not selling loads and loads of units in a single market. The focus shifted from there because there just isn't the cash. There is often the desire but not the cash, at least early on,' he explained.

Instead the company aims to become the Dell Computer of fuel cells – a systems integrator. 'We can create a full service company that goes from initial design to final deployment. We're trying to develop a technology platform where people can come and say "I have a problem. How can I use fuel cells?" so let's work with you to design a product you can use.'

Aside from the very significant CO₂ savings and market potential, there is something wonderfully tangible about cars - when we try to explain what we do to the lay-person, it all suddenly becomes clear when we say - see that car on the road, we put the fuel cell in it which powers the electric motor - **Dr Ben Todd**

Product developments



So Arcola Energy is casting its net wide. It is integrating fuel cells into lightweight electric vehicles, working with two of the world-leading companies in this space, Microcab and Riversimple, both of which are UK-based. 'Aside from the very

significant CO₂ savings and market potential, there is something wonderfully tangible about cars - when we try to explain what we do to the lay-person, it all suddenly becomes clear when we say - see that car on the road, we put the fuel cell in it which powers the electric motor,' said Ben.

The company is also building on its Hylight technology platform with a project aimed at the construction industry. 'We are presently looking at welfare cabins. In the construction industry lots of places are running diesel generators to power tiny loads. The cost savings from fuel cells start to make sense. The construction sector is a genuine market. '

Using a grant of £199k from the Technology Strategy Board Arcola Energy is working with BOC and **Re Hydrogen**, a small hydrogen technology company, on a project to bring down the cost of fuel cell energy systems in this market. The Technology Strategy Board is contributing £443k of the total project cost of £886k of the three-year project.

It is not just the funding that makes the Technology Strategy Board's contribution so vital. 'Cash is a simple idea, but collaborative R&D is what I really like. Out of the Technology Strategy Board we've got some really strong commercial relationships. It de-risks building a new partnership.'

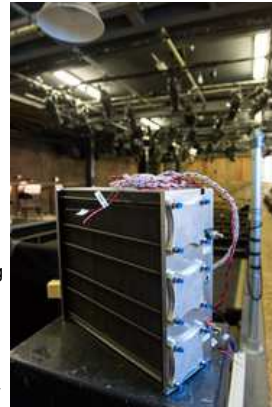
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Arcola Energy is working with a 10 other partners ranging from **ITM Power** to **Toshiba Research Europe** on a project called Island Hydrogen that aims to demonstrate low-carbon hydrogen fuel for passenger cars and boats. It is a £4.6m project on the Isle of Wight which has received £2.3m in funding from the Technology Strategy Board and runs until 2015.

Everlasting solutions

And then there is the Green Hydrogen project. Arcola Energy is working with a consortium of companies including RE Hydrogen, **Juwi Renewables**, **Revolve Technologies**, **flexitricity** and **Rutland Management** to demonstrate a viable solar-hydrogen energy system by providing constant green electricity and heat to the **Dunstable Park business park**.

The Technology Strategy Board is instrumental in getting these kinds of projects going. 'The Technology Strategy Board application format is very clever; it's a really useful way of building a project. And it helps that it is a very well-run organisation,' he added.



At the same time as it is involved in these projects, Arcola Energy provides an educational service for schools. It delivers innovative and inspirational workshops using renewable energy technologies to design, build, and explore the possibilities of a low-carbon future. The headline events of which are the **London Schools Hydrogen Challenge** and the **Abu Dhabi Science Festival**.

These bring cash into the business, as do the educational kits Arcola Energy offers. These are based on products manufactured by **Horizon Fuel Cell**, a Singapore company, as are the fuel cells that Arcola Energy sells. 'We've had sales from day one because of working with Horizon, and we've set up a very, very diverse cash-source business model,' said Ben.

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And the theatre continues to play an important role as a showcase for clean technology. Arcola Energy's recent projects include using DC microgrids to turn the theatre into an urban power station, generating and using its own electricity. 'PCs and other gadgets run on Direct Current (which is what fuel cells provide). We're looking at how we can distribute it around homes and offices, and a £24k grant from the Technology Strategy Board is helping fund a feasibility study.'

Arcola Energy now has 12 full time employees and is presently recruiting for mechanical, electrical and software engineers. 'People ring us up with crazy projects and we're quite good at putting things together. I think that diversity is one of the things that gets the Technology Strategy Board quite excited.'

STOP PRESS –

Arcola Energy announces formation of new UK Joint Venture company with Horizon Fuel Cell Technologies (Singapore) to manufacture fuel cell stacks in the UK for automotive customers. The new company, Horizon Fuel Cell UK, will operate from Arcola Energy premises in East London and at the Imperial College Incubator in West London.

Arcola Energy announces supply agreement with **Riversimple** to provide 10 twin-stack fuel cell systems in 2014. Subject to meeting technical milestones, this will lead to ongoing supply in to the next generation of Riversimple vehicles from 2015.

- TECHNOLOGY STRATEGY BOARD REFERENCE POINTS FOR ARCOLA ENERGY

Thematic programme areas:

Energy



Our energy programme will commit up to £35m per annum to specifically help UK industry profit from the changes the world will have to make to address the 'trilemma' of energy security, affordability and sustainability.

High value manufacturing



High value manufacturing uses leading-edge technical knowledge to create products/processes. Manufacturing makes up 54% of UK exports and employs 2.5m people. Companies need to commercialise more output from the UK science base.

Innovation support tools:

(There are 13 Technology Strategy Board **innovation support tools** altogether)

Collaborative R&D



Collaborative R&D helps companies tackle specific technical or societal challenges by working collaboratively to create new products, processes and services. It encourages knowledge exchange, supply chain development and parallel working on complex system challenges.

Collaborative R&D co-funds innovative projects involving partnerships between businesses, and between business and academia.

Feasibility Studies



Feasibility Studies are to help companies, either singly or in collaboration with others, to access the potential of ideas in specific thematic areas. Success may position a project well to enter larger programmes funding collaborative R&D, such as those supported by

the Technology Strategy Board and the EU.

The Technology Strategy Board is the UK's innovation agency. Our goal is to accelerate economic growth by stimulating and supporting business-led innovation.

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