

2014 IChemE Presidential Address

Chemical Engineering Matters

reflections on a journey from academia, to industry, and back again...



Professor Geoffrey Maitland FREng FIChemE

Imperial College London

Wednesday 28 May 2014

Chemical engineering matters everywhere - reflections on a journey from academe to industry, and back again

Institution of Chemical Engineers Presidential Address, May 28th 2014

Professor Geoffrey Maitland FREng FIChemE

1. Introduction

How did I come to be standing here? I think it was John Lennon who once observed that life is what happens when you are planning something else – I know exactly what he was talking about. For the last nine years I have been professor of energy engineering at Imperial College London, carrying out research with my students and colleagues, many of whom are here tonight, on a variety of topics right across the energy landscape, from clean fossil fuels to green algae as a source of renewable hydrogen.

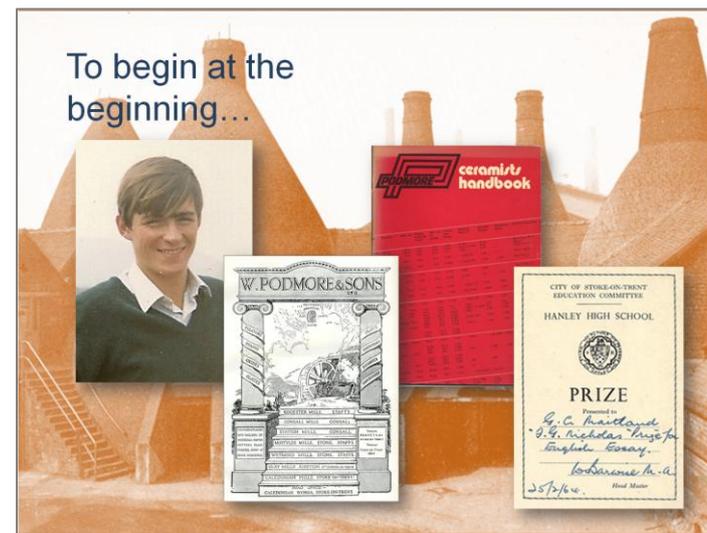
To explain how I came to this life of engineering and to be working on what I consider to be probably the most important challenge facing the world in this 21st Century, I want to take you all on a journey, which began in Stoke-on-Trent in the 1940's, and tell you about some of the doors that opened up along the way. And I want to use this journey to comment on some of the challenges and opportunities for chemical engineers today and what I would like to achieve for the Institution and our profession as your President.

2. Early beginnings... a first taste of Engineering

As Dylan Thomas said, "To begin at the beginning..." I was born in Stoke, the Potteries, so you will not be surprised to learn that my father worked in the pottery industry, at a company called Podmore and Sons. They made and processed the raw materials for making pottery...the clays, the refractory frits and the glazes. As a youngster, we lived opposite the

Podmore factory and I can remember my mother moaning because whenever the dull background noise of the ball mills and furnaces stopped in the middle of the night, my father, the works manager at the time, used to wake up and go across the road to sort things out – way before remote computer control, he had his own in-built sensor system that there was a problem. This connection to Podmores opened a door to some summer vacation work and was my first exposure to both industrial chemistry and to engineering.

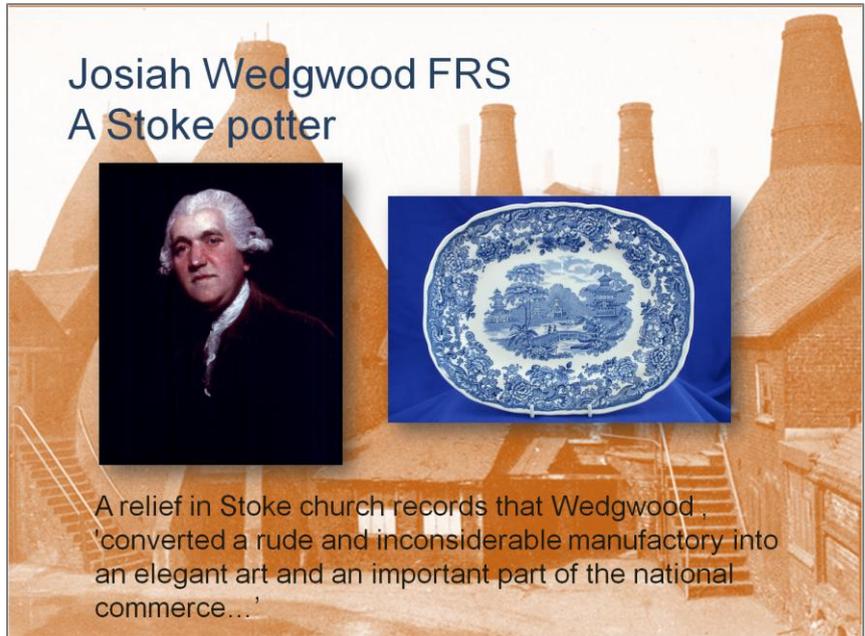
My time at Podmores presented me with two other opportunities. I wrote my first



book – the excitingly titled *Ceramicists Handbook*, which documents such engineering delights as degrees Twaddle and Von Kobell's scale of mineral fusibility. And at school I won the 6th Form English Essay Prize for 1964 with an account of the design and operation of vibro-energy mills, a Podmore invention to replace traditional rotating ball mills for grinding zirconium sand for glazes, which I had been assigned to test out that summer...much to the chagrin of

my Lower 6th Arts friends, who thought that a prize for English Essay ought to be about Shakespeare or Gladstone. So I guess this was an early appreciation of the value of explaining complex science and engineering to non-technical people.

Probably the most famous Stoke Potter was Josiah Wedgwood, one of the great engineering entrepreneurs of the industrial revolution. A Fellow of the Royal Society, Wedgwood was responsible for the industrialization of the ceramics industry in England and played a large role setting up much of the rail and canal infrastructure which was essential for the widespread impact of engineering in that era. He was second to none in lobbying parliament and raising venture capital...so we should not forget that the impact of engineering in the 19th Century owed much to the political persuasiveness and entrepreneurial skills of the engineers, as well as to their great engineering inventions.



In our current era of the electronic revolution, where I contend that we desperately need to accelerate the energy revolution, we need to restore the political influence of engineers to create the right environment to bring about engineering change which is not necessarily driven entirely by the market.

Actually the most famous Stoke Potter is not, Josiah Wedgwood. It is, of course, Sir Stanley Matthews, the Wizard of Dribble, the very first European footballer of the year in 1956 and one of the greatest players world football has ever seen. In fact my father played against Matthews when they were at school. He first took me to the Victoria Ground when I was about six years

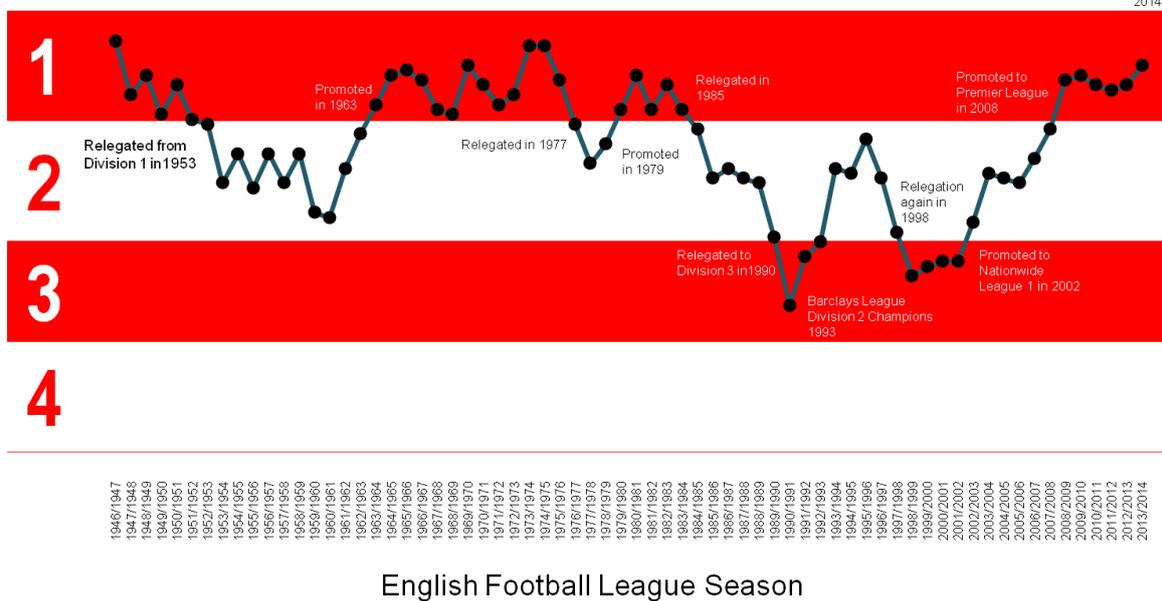


old. Despite getting soaking wet on the uncovered Stoke End watching a goalless draw against Bury in the old 2nd Division, I was hooked and I have remained a proud, long-suffering supporter all my life. A difficult cross to bear at times but football can be a metaphor for life more generally and being a Stoke supporter definitely prepares you for life's disappointments – and I suppose makes you thankful for small mercies.

Life's ups and downs I The fortunes of Stoke City FC



9th place in Premier League 2014



So let's look at one of the barometers of my journey – Stoke's league position since 1947. Quite a bumpy ride! Although they finished 4th in the old first division in the year of my birth, still their highest position ever, Matthews left Stoke for Blackpool one month after I was born, and for the first 14 years of my life it was all downhill. But then, a miracle happened. In October 1961, Stoke's manager Tony Waddington managed to persuade Matthews, then aged 46, to return to Stoke – and the rest is history. In my vibro-energy days at Podmores, in 1963 Stoke were promoted back to the old first division – the Premier League to those of you under 30 – after ten years in the wilderness. Life was on the up. For the record, on my other journey barometer which we will come to later, crude oil was trading at \$1.8 per barrel.

3. Research to Academe to Industry and back again

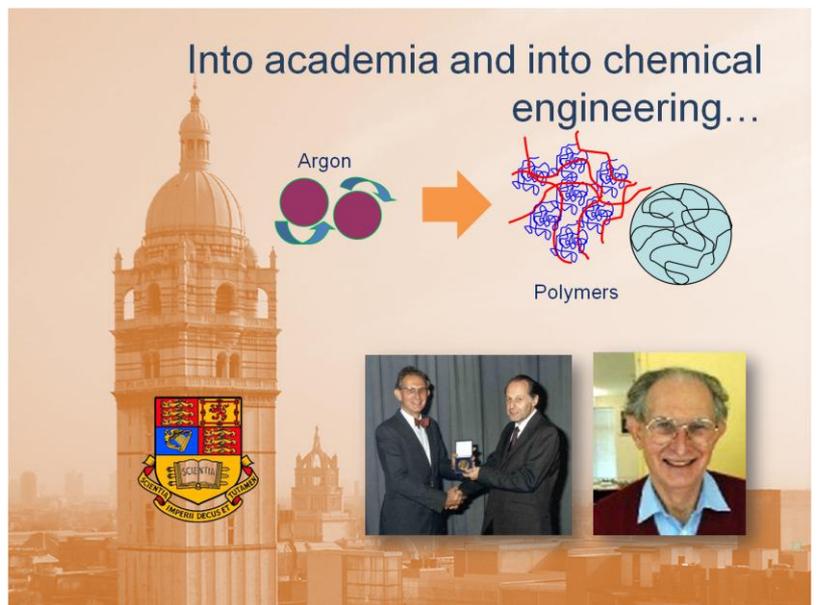
Research beginnings

Amidst all of this euphoria, my love of science, and chemistry in particular, led me to study the subject in Oxford, whose delights, particularly watching cricket in the Parks, I enjoyed so much that I stayed on to acquire a doctorate in physical chemistry. My supervisor and mentor was Sir Brian Smith who taught me many things, including how exciting and rewarding research can be, how you need to take risks to make step changes, how to combine rigour with pragmatism, how not to tackle at 5-a-side football and how to bend your first serve both ways. My focus on energy moved on from vibro-energy to the

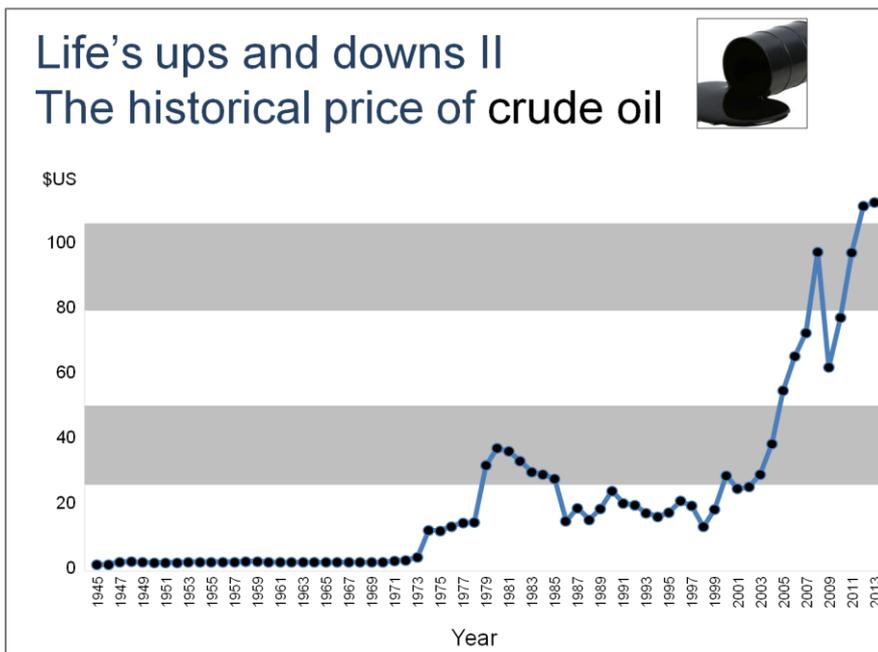
energy between molecules and how this determines the transport and thermophysical

properties of fluids – a topic that has stayed with me throughout my career. I could not exactly claim to be working on industrial fluids at that stage though – mainly on inert gases in fact.

I gained my first real-world contact with industry courtesy of an ICI research fellowship at Bristol University, jumping from argon to large polymers. Then in 1974 I was recruited by Anthony Pearson to join the Chemical Engineering Department at Imperial College. He offered me a lectureship in polymer rheology (or as my first grant appeared in the Imperial Reporter – ‘polymer theology’).



Stoke's fortunes were on the up too. As I moved to Bristol, Stoke won their first – and to date only – major trophy, the 1972 League Cup, and on my arrival at Imperial had finished 5th in the old first division...almost back to where they were when I was born! The oil price was also on the up, heading for \$12 bbl as a result of the OPEC embargo.

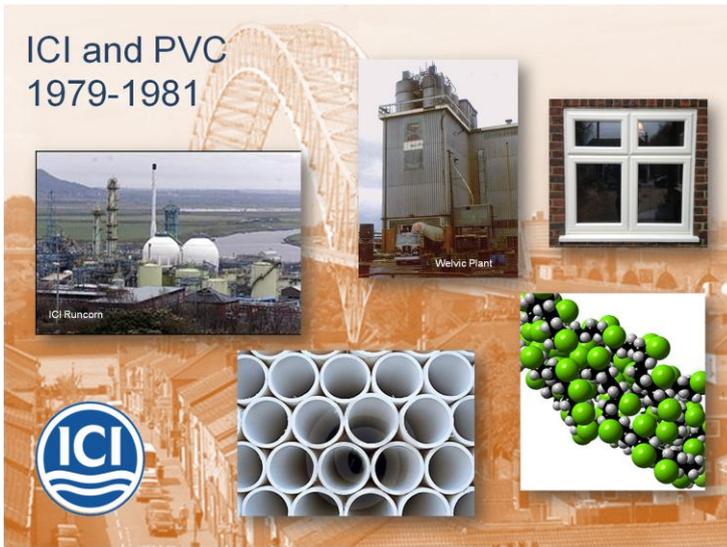
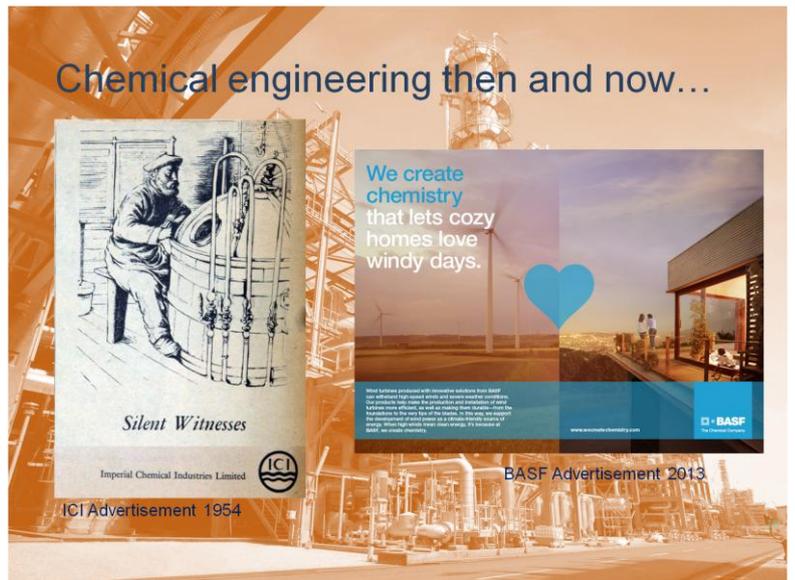


I thought I was going to be a chemist for life but Pearson had opened the door to chemical engineering and I had walked straight through it. Again I was really lucky – not only did Anthony open my eyes to the world of engineering and how to tackle engineering problems that need to be solved rather than scientific problems that can be solved, but he also shared with me his industrial contacts, particularly at ICI and Unilever. I had started research in polymer reactor engineering and in 1979 ICI asked me to join them

on a two year secondment. Another unexpected door had opened, this time to life on PVC plants – Imperial agreed and so again I walked through it.

ICI, sadly no longer with us, but in its time of course the flagship of the UK chemical industry, can help us see the enormous changes in chemical engineering that have taken place over my lifetime and how the vision and ingenuity of our profession has transformed the way industrial processes are designed, optimized and controlled. Let's quickly look at an example from the ICI archives:

This is an advert from 1954 called Silent Witnesses. This shows how process monitoring and control, and the life of process operators, have changed radically over the years and brings home just how relatively crude process monitoring and control was only fifty years ago and how chemical engineering has exploited the electronic revolution in both sensors and computing power to make processes more precise, safe, productive and less wasteful...all in my lifetime.

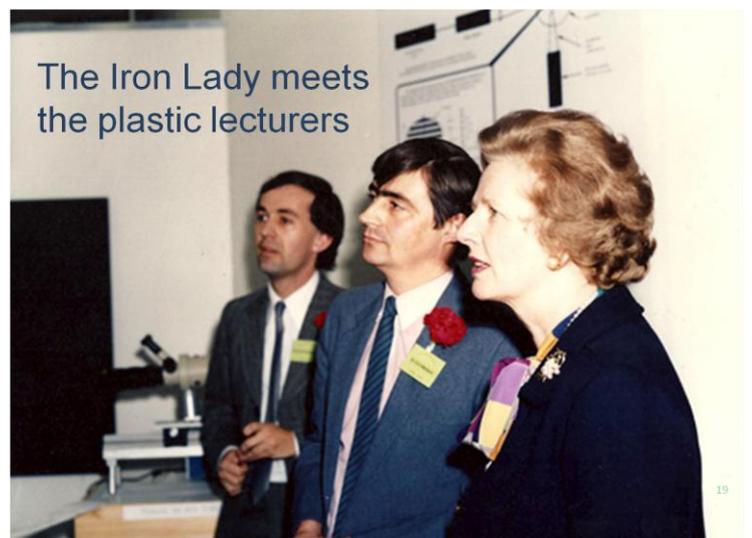


My secondment with ICI, working on optimizing PVC reactors at Runcorn and Welwyn, was an invaluable experience and I returned to Imperial in 1981 with enough polymer research problems to keep me going for a lifetime. Here you see Margaret Thatcher, taking a breather from the miners' strike, visiting Imperial in early 1985 and being enthralled with a demonstration (of another sort) of measuring flow in stirred polymerization reactors given by myself and my very young colleague Stephen Richardson.

The Lady does not look convinced! Soon after Mrs. Thatcher's visit, along came

oilfield service company Schlumberger, in the guise of Chris Hall, who I am also delighted to see here today, and asked me if I was interested in joining the new lab they had just set up in Cambridge. The more I thought about it, the chance to escape the cold climate which the UK academic community faced during the years of the Thatcher government suddenly looked quite attractive. ICI had whetted my appetite for industry more than I had thought, so with Britain slowly emerging from the miners' strike and Stoke newly relegated to the 2nd division again, I found myself saying 'Yes'.

Another unexpected door had been opened for me, this time by Chris Hall, and once more I stepped through it, albeit with a sharp nudge from the Iron Lady. I thought I was an academic for life and suddenly there I was in the oil



and gas industry. That said, it almost didn't happen, given that on the day I accepted the job in November 1984 crude oil was trading at over \$30/bbl but on the day I joined in February 1985 it was somewhere below \$10/bbl. Nonetheless, Schlumberger held their nerve, and so my new role in industry was underway and it gave me an amazing two decades of challenges and opportunities.



My technical forte continued to be fluids engineering – designing new and better fluids for recovering oil and gas. Indeed when I moved to a new job in Paris, my colleagues presented me with some new business cards describing me as a 'Fluids Stylist'. In a range of senior technical and managerial roles, I was exposed to a wide spectrum of oil field engineering right across the exploration and production life cycle, from research to field operations. Chemical engineering mattered to Schlumberger's business and my chemical engineering skill set was deployed in drilling oil wells through

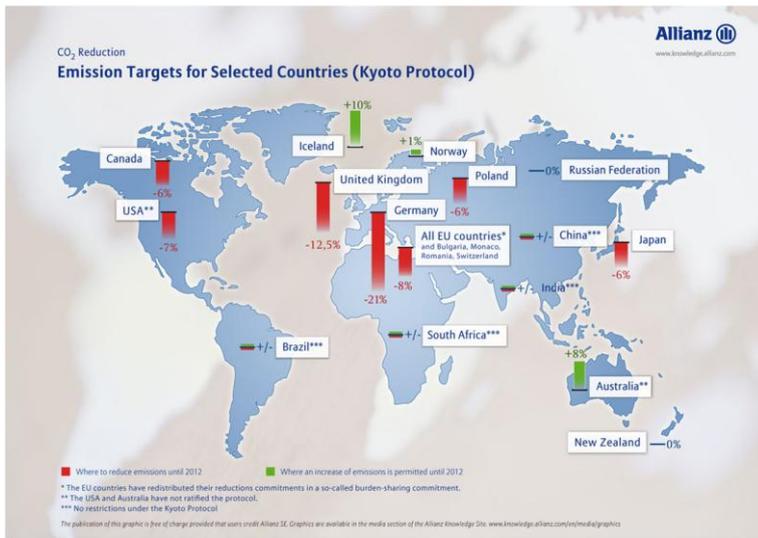
shale beds, in the use of smart fluids for fracturing reservoirs – yes, I was involved in 'fracking' well before shale gas was ever seriously considered a viable, let alone an essential, source of energy - and in new and novel ways of managing reservoir recovery, by tracking and controlling fluid movements in real time.

This so-called 'Real-time Reservoir Management' brought me onto the IChemE radar via a paper published in Chemical Engineering Research and Design along with Reid Smith in 1999. We were delighted to receive the Hutchison Medal in recognition of our work.

Part of my role was carry out collaborative research with universities so I was fortunate to be the industrial supervisor of some excellent PhD students, including with Malcolm Mackley in Cambridge.



Anyway, these Schlumberger days were exciting times, with a chance to see the world and rarely a dull moment. I spent most of my time working on technologies that could still be profitable with oil at \$15-20/bbl. Sadly, things weren't looking so good for Stoke City, who were now battling away in the Nationwide Division Two – Stanley Matthews knew it better as the old third division!



In the wider world new factors were at play. In 1997 more than 190 nations had signed up to the Kyoto Protocol adopted by United Nations Framework Convention on Climate Change, setting targets for reductions in carbon emissions. I could see some exciting research opportunities emerging, notably in decarbonisation of energy production from fossil fuels. But it was very difficult to tackle decarbonisation within Schlumberger...I needed to work directly with other stakeholders...but how?

4. I shall return

So just when I thought I was in the oil and gas industry for the rest of my career, along came Imperial College, thinking about setting up a new concept, an umbrella 'Energy Futures Lab'. It was clear to me that these decarbonisation issues could only be properly explored by strong engagement with the oil and gas operators and the power generators. And so the prospect of being able to do this through Imperial's new Energy Futures Lab proved too tempting to ignore.

And so it was that in 2005 another door opened. I shall be ever grateful to Stephen Richardson, then head of the chemical engineering department at Imperial, for giving me the opportunity to return to Imperial to get involved in tackling these major challenges.

The Stoke potter(s) makes a comeback...

Matthews scores for Stoke in May 1963 to win Promotion to Division 1 for Stoke

Matthews wins the Cup for Blackpool in 1953 - 'The Matthews Final'

Maitland returns to Imperial College in 2005!

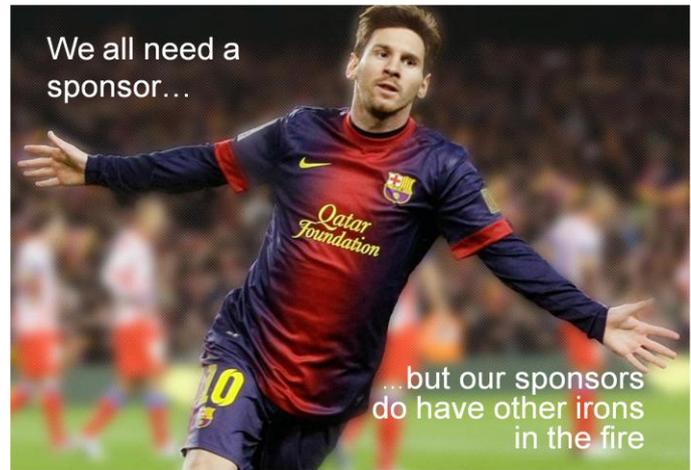
I thought long and hard before returning to Imperial College. They say you should never go back. The current head of chemical engineering, Andrew Livingston, has repeatedly commented that to expose yourself to the rigours of Imperial College once is brave, but to do so twice can only be thought of as insane! But my gut instincts were that

this was the right thing to do, to go back not to recreate the past but to do something entirely different. And my instincts have been proved right – the last ten years have been the most exciting and stimulating of my career.

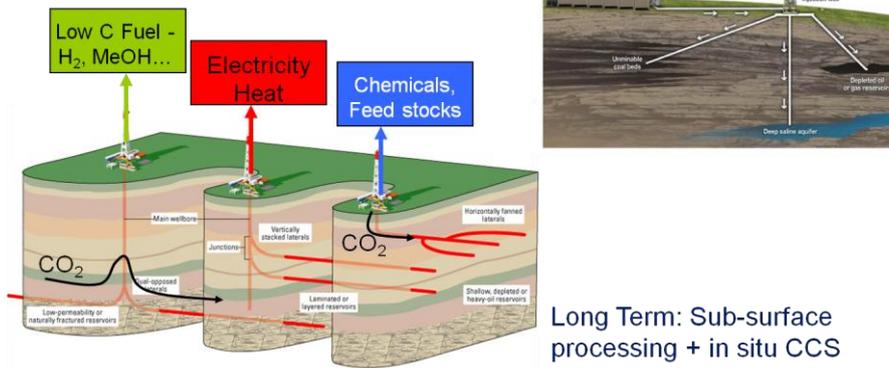
So I returned, just like Stanley Matthews did to Stoke City in 1961. He was 46 at the time; he transformed Stoke's fortunes and played in the top division until he was over 50. I was in my 50s as well – could I survive in the Premier League of academia? Could I make a difference too, make a useful contribution to my old club? Make no mistake; I did not make the move without some fear and trepidation. I had not applied for research funding for over 20 years.

But here was an opportunity to involve myself in something that had the potential to change the game, just like Matthews did in the 1953 Cup Final (albeit for Blackpool rather than Stoke).

Things were on the up – Stoke narrowly missed out on the play-offs for the Premier League and oil was trading at \$70bbl. But where was my funding going to come from? For the answer we can turn to another European Footballer of the Year, Barcelona’s Lionel Messi. Stoke City supporters can only dream of Messi playing in red and white. He’s still at Barcelona, but look at his shirt. Barcelona are sponsored by Qatar Foundation. Well as it happens so am I – or at least the research centre of which I have been the Director since 2008 is, along with co-sponsors Qatar Petroleum and Shell.



A vision for clean fossil fuels



When I returned to Imperial in 2005, I sat down with a group of colleagues (Martin Blunt, Sandro Macchietto and Martin Trusler) and set out a vision for Clean Fossil Fuels. In a nutshell the short term plan is, where CO₂ from coal, oil or gas is released centrally, to capture it and store it underground...carbon capture and storage (CCS). The more ambitious long term approach involves sub-

surface processing taking classical surface chemical engineering into the miles of underground wells which become tubular separators and reactors, fuelled by some of the *in situ* hydrocarbon.

Well, we took this vision to Shell, who liked it and quickly sponsored the Shell-Imperial Grand Challenge Programme in Clean Fossil Fuels starting in 2006 and then in 2008 joined forces with the Qatari partners to sponsor the Qatar Carbonates and Carbon Storage Research Centre, QCCSRC, a \$70M, 10 year highly multidisciplinary programme. This involves over 60 researchers providing the underpinning science and engineering for the safe storage of CO₂ in carbonate reservoirs and saline aquifers, linked to using CO₂

**A 10 year, \$70m programme
"Putting CO₂ in its place"**

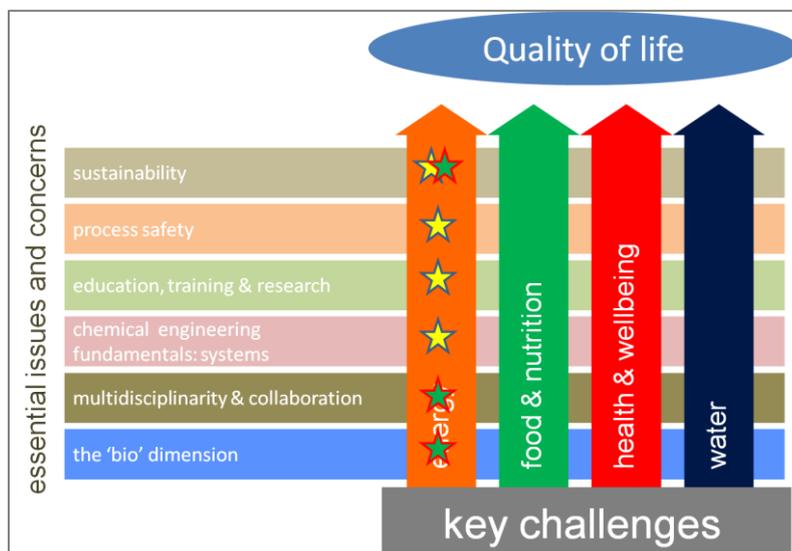
- 17 Academic Staff
- 3 QCCSRC Lecturers
- 10 Postdoctoral Researchers
- 34 PhD Students
- 5 Technical Support Staff

for enhanced oil recovery as well. It is the most exciting venture I have ever been involved with – our strap line is ‘Putting CO₂ in its place’.

And given that crude oil in 2008 was now nudging \$100bbl all manner of possibilities were opening up. The possibilities were looking good for Stoke City too – they were promoted to the Premier League the year that QCCSRC started, after 23 years in the wilderness, spanning my whole career in Schlumberger!

5. Chemical engineering matters to Maitland, but where do you fit in?

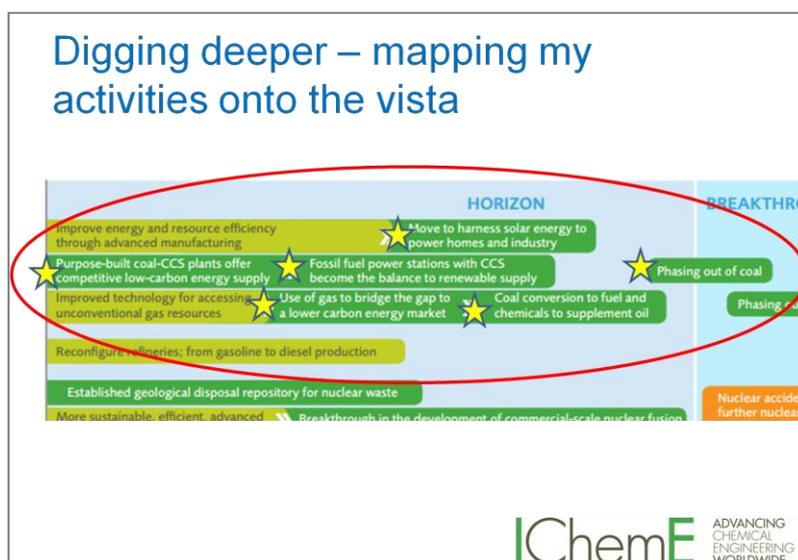
I make no apologies for repeating the buzzwords, ‘chemical engineering matters’. It’s not a cliché, it’s the truth and I am a very enthusiastic supporter of the *Chemical Engineering Matters* technology strategy, which was launched last year by my predecessor, Judith Hackitt. I have picked up the baton from Judith and will carry it forward in my presidential year. The original report was a sell out and we now have a second edition. It provides an underpinning philosophy for everything that the Institution is doing and I think it’s important that we all understand where we fit in.



So, here’s where I fit in. This is the quality of life model that sits at the heart of the chemical engineering matters proposition. How does my current work contribute to creating, maintaining and improving quality of life? Well I can map my work on clean fossil fuels onto the model where you see the yellow stars; and my work with Klaus Hellgardt on solar hydrogen using green algae and cyanobacteria relates to the model where you see the green stars.

Chemical Engineering Matters contains another feature – technology landscapes or *vistas* for energy, water, food and health. Here is the Energy Vista – it identifies the energy solutions that are available now, in the near term and some of those that are on the horizon. I can map my activities onto the vista also, as you can see from the yellow stars. I have moved from where I was in Schlumberger on the left-hand side, now and near-term, to working on the horizon and am trying to haul the horizon in so that we get there sooner rather than later.

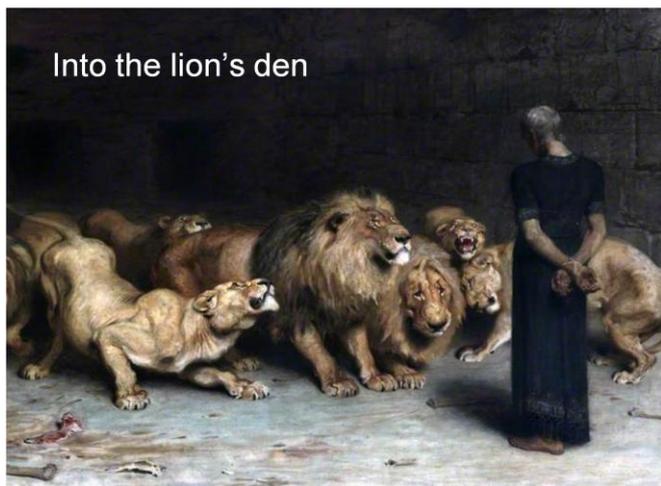
Every chemical engineer, be they in industry or academia, operations or R&D or marketing, in research or teaching, can do likewise. I encourage all our members through



their work with the Special Interest Groups and Regional Member Groups to identify where you are making a difference...and where the gaps are that collectively we need to do more about. Try it. Tell us your story and where you fit in. And more importantly, tell others – we've got some fantastic stories to tell.

Chemical Engineering Matters is an evolving strategy which needs to change as our ideas and activities for the future change and adapt to what works and what is needed. You, the members, are the people who are changing the landscape – let us know how you are changing it so that others can benefit and build on it.

6. Into the lion's den



We can do our level best to set the agenda, but it's a harsh fact of life that sometimes, 'events' will set the agenda for us. Then you find yourself in situations you have never planned or anticipated. My wife Margot and I were just flying out of Houston on 21st April 2010, on the first flight out after the Icelandic volcanic ash eruption, when we heard a brief news story that an oil rig had caught fire in the Gulf of Mexico. This was Deepwater Horizon, the Macondo well, which eventually became the largest blowout and offshore oil spill in history – little did I know that this incident was going to fill my life for the next 85 days and

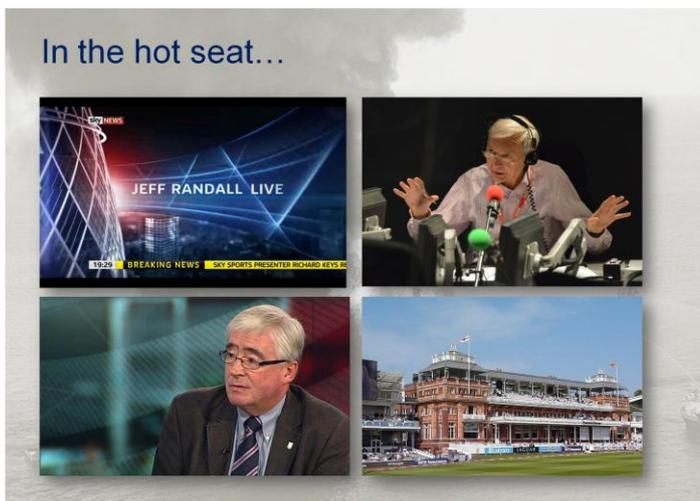
beyond.

Back in the UK, the story was beginning to build. So the media were clamouring for informed commentators with a good knowledge of oil field and oil well management, who were not gagged by working for BP or indeed for anyone in the industry, and who were willing to put their head above the parapet...and there were not too many around. The press offices at both IChemE and Imperial came in hot pursuit and another new door opened in front of me – this time it led to the TV



and radio studios and a string of interviews with the likes of Jeff Randall and John Humphries.

Pretty soon I found that my chemical engineer's perspective on this was in great demand. I gave 60 interviews in 95 days, sometimes at the drop of a hat in odd locations, including by Skype from a hotel room in Japan and memorably from behind the pavilion at Lords. Hopefully by speaking to a wider audience, people



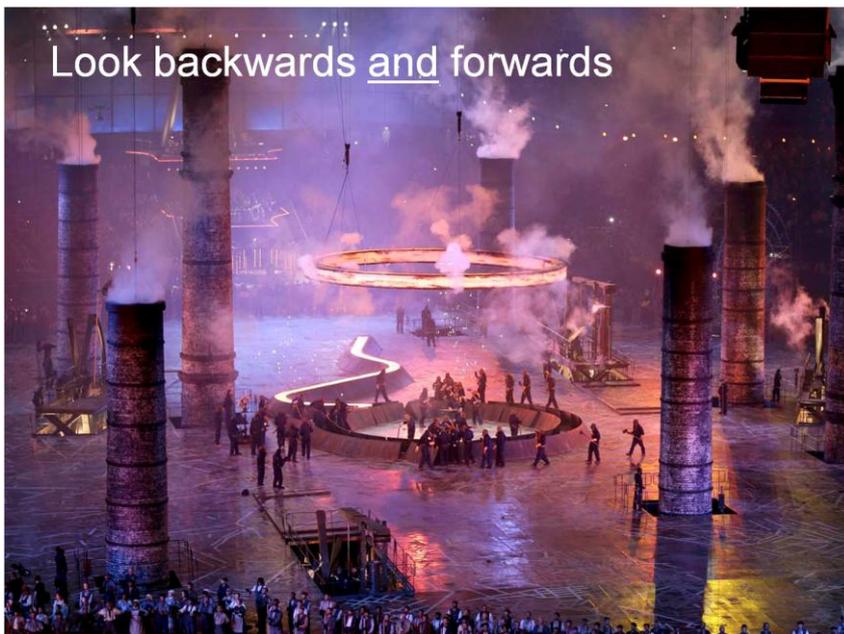
realised that chemical engineering matters and that just as poor engineering practice was part of the problem, good engineering practice was key to the solution.

IChemE's communication team were sufficiently impressed with my performance in front of the microphone to recognise me with the *Media Envoy of the Year Award* in 2010. Here I am with some proper media stars, shortly before an in-depth discussion with Ray Stubbs and Mark Lawrenson on Stoke's chances of survival after two years in the Premier League.



Since then, I found more and more media work being passed my way. I was also called on by the Department of Energy and Climate Change to Chair the UK Offshore Oil and Gas Regulatory Review in 2011, analysing the lessons from Macondo and recommending how UK procedures needed to be improved to ensure that there is never a repeat performance in UK waters.

Unfortunately, this was bad news, where poor engineering practice was seen in a bad light. Far too often we are called in to explain ourselves and defend our profession and industries whenever there is a major problem. The NGOs can use hyperbole and paint the blackest picture to try to block engineering innovation. Let's face it, we have not yet found good ways to explain to the public the difference between hazard and risk, that risk and uncertainty are inevitable in all human endeavour but that their careful management renders potentially dangerous processes as acceptably safe as driving a car or having a barbecue.



So I am tired of the media only calling on us to comment on bad news. We need to make more noise about the good news. It's all very well celebrating the industrial revolution as we did in the opening ceremony at London 2012, but we shouldn't dwell on the past all the time; there's been no end of engineering good news since then and lots of fantastic role models since Josiah Wedgwood and Isambard Kingdom Brunel. Let's celebrate the present, let's celebrate the impact that chemical engineers make in the 21st Century. Doing just this - celebrating chemical

engineering - will be a central theme of my presidential year.

7. Celebrating Chemical Engineering – ChemEng365

Chemical Engineering Matters is not merely an internal planning tool; it is a vehicle for public engagement and informed communication with government, NGOs and other stakeholders. Some of you will have heard me trailing the notion of 'Chemical Engineering Matters 365' or *ChemEng365* as it is now called. Chemical engineering matters – and it matters every day of our lives. It matters everywhere we are, it surrounds us, enabling the quality of life we are privileged to enjoy in our comfortable part of the world; and it will enable us to tackle, successfully I believe, the major global challenges to deliver energy, water, food and health to the whole global community. So in twelve months time I want to be able to look back on a year during which chemical engineering mattered on every single waking day.

As of this morning, I've entered the blogosphere with my *ChemEng365* blog and with the help and support of Andy, Alana, Alex, Tony and Trish – the *Chemical Engineering Matters* team – we're going to make sure that chemical engineering good news is going to be flagged, day in day out for the duration of my presidency. You can find the blogs at <http://ichemepresident.wordpress.com/>

Today, I've been highlighting the use of graphene to make batteries light, durable and suitable for high capacity energy storage from renewable generation.



Tomorrow, we are featuring encouraging news on the efficient production of biofuels from micro-algae. On Friday, we are looking at how nanotechnology is turning millennia-old winemaking on its head. Then, we will be celebrating the achievements of Norwegian Oil and Gas company Aker Solutions and their contribution to talent management of their chemical engineers. And on Sunday, it is appropriate that we mark the 40th anniversary of Flixborough. Despite the tragedy of this event its influence on process safety has been

significant and has undoubtedly saved lives. Next week, I will be congratulating 30 new IChemE Fellows.

And it will carry on for the weeks and months ahead - products, projects, processes, people – the stuff of 21st Century Chemical Engineering, and its applications, making an impact on quality of life and on virtually everything that surrounds us.

In twelve months time we will have a repository of case studies, profiles, pictures and video clips that will leave people in no doubt that chemical engineering matters. Let's shout it from the rooftops – and I want you all to be part of it.

Later in the year we will be recognising every idea that you bring forward with a unique gift – IChemE's equivalent of a 'Crackerjack' pencil for those of you that are old enough to remember that. And at the end of my presidential term I intend to recognise the best submissions to ChemEng365 at a series of special events around the world, with some ChemEng365 medals and, in some cases, to reflect my Josiah Wedgwood roots, with a piece of Staffordshire pottery.

8. Communicating Chemical Engineering – speaking out

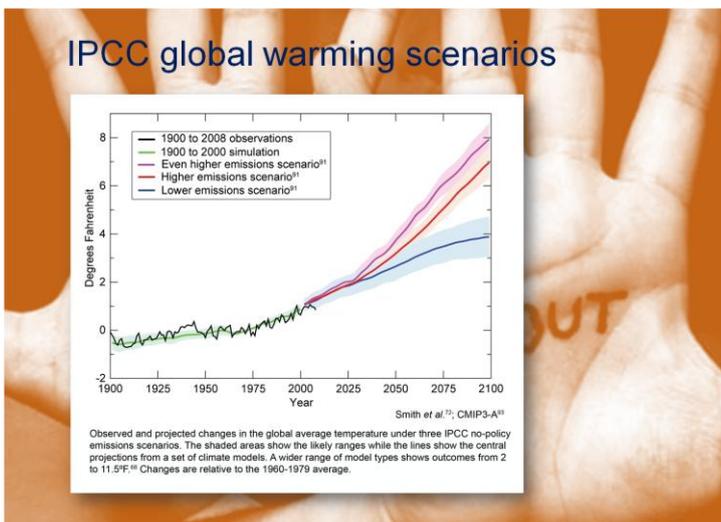
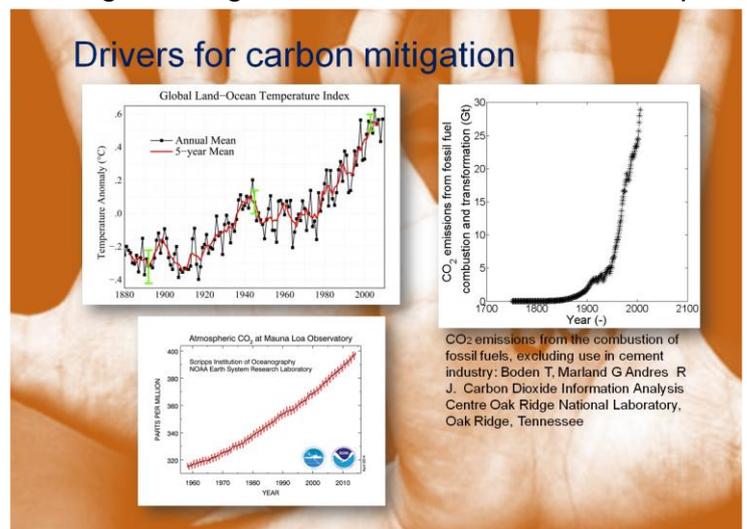
As well as a celebration of Chemical Engineering achievement and potential, ChemEng365 will be a vehicle to improve the impact of our communication – the second main theme of my



Presidency. I want us all to be more active in emphasising to those outside our profession the value of chemical engineering as an agent of 'change for good'. Be it with government, NGOs or the general public, we engineers are not as effective as we might be at conveying what we do, what needs doing and what we could do to get that done.

Let me try to illustrate what I mean by taking my own area of future energy and climate change avoidance as an example. Although great progress has been made in convincing governments and the public that

climate change is a reality (with some obvious sceptical exceptions), convincing them of the need to respond quickly enough and on a large enough scale to avoid its catastrophic consequences is proving very difficult. I believe that this is in part due to the fact that scientists and engineers are used, in giving evidenced-based opinions, to giving an entirely balanced view of a problem and reflecting the doubts, balance of probabilities and alternatives alongside the most likely conclusion or solution. On the whole, most people, including politicians and NGOs, want to see things much more in black and white terms. So I believe that sometimes we as a profession should be much more plain speaking and cast aside some of our inhibitions born of the scientific method.

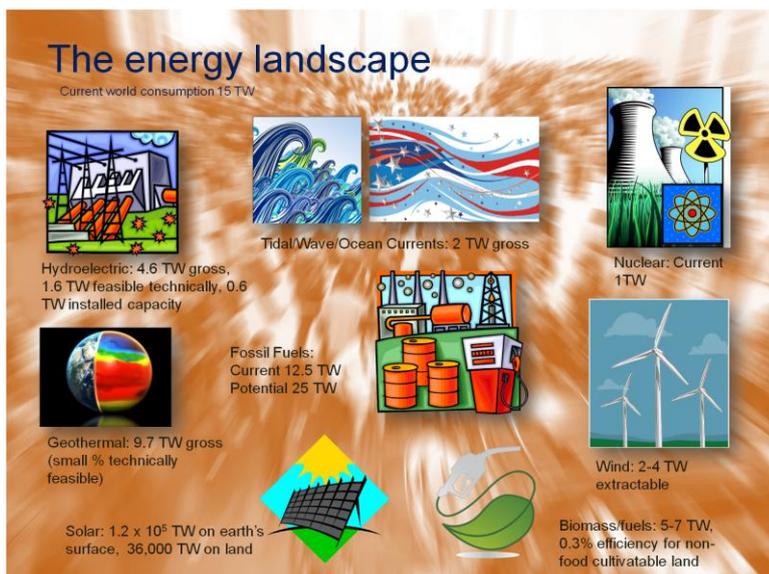


So speaking in this spirit, I believe that we are sleepwalking into a catastrophic global disaster as a result of not acting quickly and collectively enough to address impending climate change with a wide range of carbon mitigation actions, all acting in parallel. In times of military war, countries and alliances have no problem in marshalling the necessary resources and acting quickly to do whatever is necessary to repel the enemy. They do not prevaricate or look for a no-cost solution. Sacrifice is an accepted part of that response. I believe that this is indeed a war, a global war, a

chemical war in fact, with anthropogenic climate change a real enemy. So we need to act accordingly. This is not somebody else's problem; it won't go away or get better if we wait. In fact the longer we wait, the more powerful the enemy and the more difficult and expensive it will be to implement the solutions. The Stern report of 2006 said this loud and clear but despite an initial nodding concern, it seems to have been largely forgotten. Nor is this a problem that we can just leave to politicians, energy companies and 'the market' to sort out - it's a problem for each and every one of us – each of us must play our part in lowering our own carbon footprint, either through energy savings and efficiency improvements or by using low or zero carbon energy and accepting that whether that comes from fossil fuels with CCS, nuclear or renewables, it will cost us more, certainly in the short term – the days of cheap energy are over, and the sooner we get used to that the better placed we will be to move on with effective solutions. And don't rely on renewable energy coming along quickly enough to solve the problem on its own, because it won't. Every individual also has a role to play by lobbying politicians and being part of a public opinion seed change that provides the impetus to make the necessary changes to political will, financial incentives and rapid technology change.

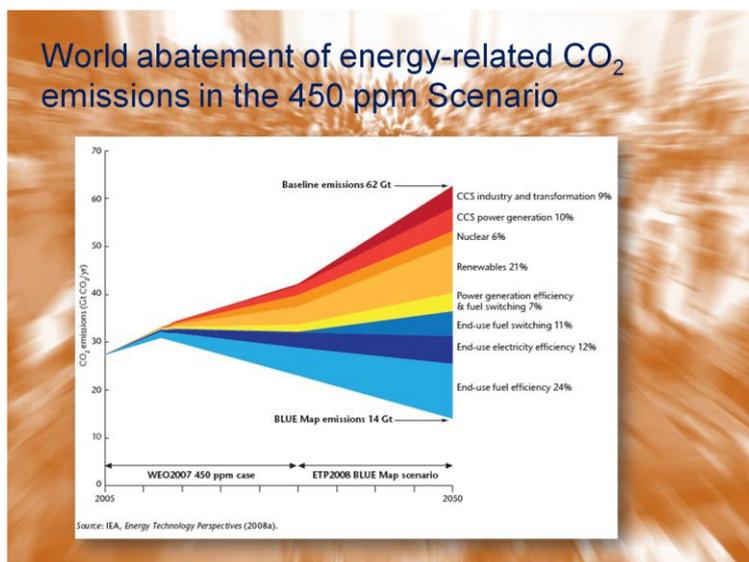


We need to personalise the arguments and the mechanisms: 'this may not directly affect you, but it will almost certainly be a reality for your grandchildren unless we take this dramatic action'. We should explore further the idea of personal carbon quotas that would bring this home to every individual and give them both the incentive to reduce their carbon footprint and also the scope to manage the way they do it, to fit best with their personal, family and career circumstances.



Of course, we need to develop renewable energy of many types as rapidly and cost-effectively as we can – and in the UK to replace and grow our nuclear capacity – but the timescales of both options is decades and even by the middle of this century we will still be using at least 50% fossil fuels. So we have got to take the carbon out of fossil fuels before it is released to the atmosphere, by CCS from centralised facilities or by keeping the carbon underground. We must also use more gas, including shale gas. We do not have time to go into the detailed arguments for and against shale gas tonight, but the focus of debate is far too often on the environmental risks from exploiting this major resource rather than stressing the large environmental benefit of 50% CO₂ reductions. As chemical engineers I believe we ought to be out there providing both the public reassurance of the net benefits as well as the safe technical solutions. The same sorts of issues arise in addressing the other major global challenges of water, food and health.

So I encourage all chemical engineers to take the opportunity to engage on these major issues wherever possible and to provide clear messages and information where you believe this is required and valid. Some will feel more comfortable with this than others, so to promote this I plan to encourage and expand our *Media Envoy*s scheme by identifying more people who want to play an active role, using IChemE to promote them and find them opportunities to access the media. I also want to identify more chemical engineering role models...young engineers who will define the future as well as those whose experience and achievement brings insight, female engineers, engineers from across the world – all making a difference, showing how chemical engineering matters and inspiring others to join the profession and do the same. I love Brian Cox and what he does – but he is not an engineer!



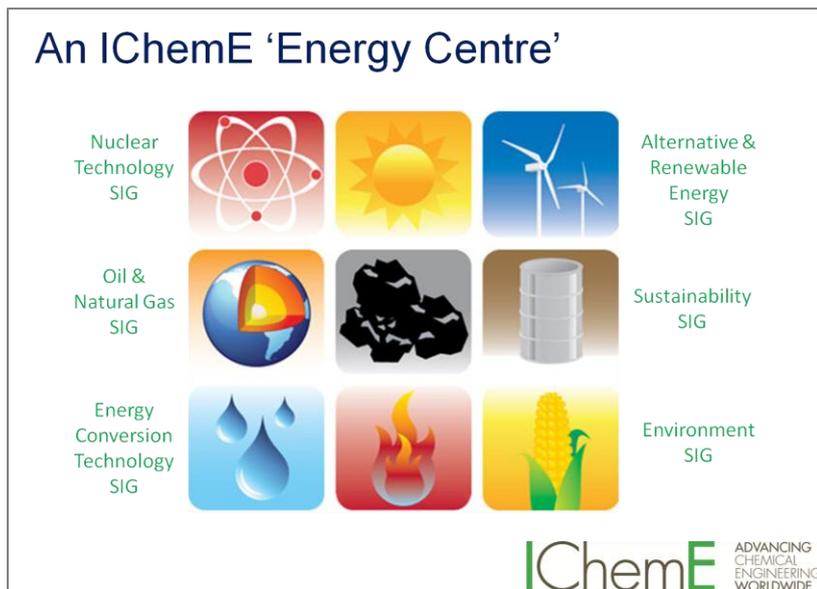
9. Building bridges



Chemical engineering is very, very important of course – but so are all the other engineering and science disciplines (although probably not quite sitting at the centre of things as we do) and we can't solve all the world's problems on our own - which brings me briefly to the third main theme of my Presidency: building and strengthening bridges to other organisations. We need to work more in partnership with key organisations and groups. We already work closely with other Engineering bodies such as RAEng and the other engineering institutions and I want to see us working even more together on communication and lobbying

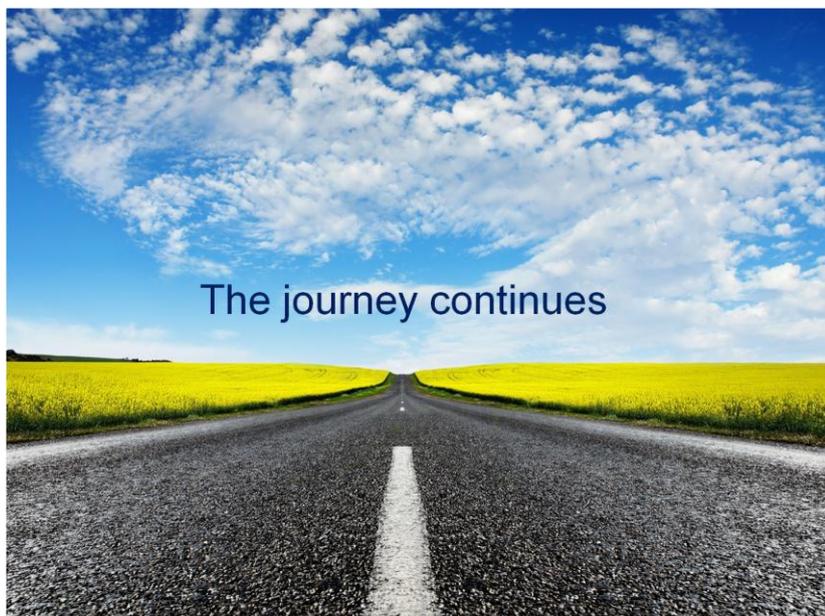
so that together we provide a more unified and stronger voice for engineering.

Given my chemistry roots, I want us to take more initiatives with the Royal Society of Chemistry – the incoming President Dominic Tildesley and I go back a long way to our PhD days and together we aim to strengthen the chemical engineering-chemistry interface at a professional level and enable both organisations to learn more from each other. Our SIGs and member groups are of course key to all we do and I plan to continue Judith's work to use Chemical Engineering Matters as a platform for activities, debate and communication, both inside our organisation and facing outwards to other groups.



In my own area of the energy domain, for instance, I will promote and expand the concept of an Energy Centre as an integrating policy and communication unit that can facilitate interaction and joint initiatives between the 5 or 6 SIGs with particular interests in the energy space and act as a more coherent IChemE interface with other stakeholders.

10. Reflections and conclusions



And so we come to the end – to the end of this address but not to the end of my journey. For tonight represents the next, very exciting step on my engineering journey to which I am looking forward immensely. It may seem a long way from the viscosity of the inert gases to trying to transform the way we use energy and to arrest climate change. But it has gone in the twinkling of an eye and each stage has broadened my horizons. There have been plenty of new challenges – and each one has been an opportunity.

Hopefully I can exploit this mixed experience of industry and academia, of science and engineering, to help IChemE to identify and take opportunities in our increasingly complex technology landscape and professional environment – to walk through the right doors. As I have said, I plan continuity with Judith's excellent Presidency, with Chemical Engineering Matters remaining at the heart of everything we do. As I embark on this latest journey, who knows what doors will open up and what opportunities are there for the taking, for IChemE and for me as your ambassador.

11. Endpoint

Thank you for the trust you have shown in me in giving me the great honour of serving as your President. I can assure you that I am taking on the role with great enthusiasm and full commitment...and will do all in my power to take IChemE from strength to strength.

Oil is now at \$110 bbl and Stoke City have finished in a record high 9th position in the Premier League. Both are on the up – and this may be a good omen.