

Energy Efficiency: Engineering Smart Cities of the Future,
UAE-UK Business Council's Energy Working Group Innovation Lecture Series,
19 January 2014

Introduction

Good morning. I want to first thank the UK-UAE energy working group for inviting me to address you. This is an incredibly exciting time for the energy sector – never have the challenges been more acute, but never have the opportunities been so great.

That is underlined by the fact that this year's World Future Energy Summit, one of the world's foremost events dedicated to renewable energies and energy efficient and clean technologies opens tomorrow under the patronage of His Highness Sheikh Mohammed Bin Zayed Al Nahyan, Crown Prince of Abu Dhabi.

Up to 50,000 people will be coming together to discuss the most innovative new technologies in the renewable energy space – and working out new ways of bringing funding and policy to bear – to support their evolution.

In the next 20 minutes or so, I would like to explore what I see as the major challenges we're facing and underline a few ideas that I think can help to guide our thinking and help us to share information between the UAE and UK energy communities which is the goal of this working group.

- First, the challenges – not only in the energy sector but wider across society.
- Next, some of the projects that are lighting the way ahead, then, I want to broaden this out to the macro scale – thinking about the vision we now need to plot the correct course.
- Partnerships – with industry peers, political decision-makers and the people. This room is a great example of what you get when you collaborate.
- Finally, technology. We are already in an age where we expect to be surprised on a regular basis. Innovation in all spheres is reshaping our world and the pace of change is increasing.

SLIDE 2: Universal challenges

Let me focus on our challenges. There are universal challenges – resource shortages, climate change and population growth. I want to focus on the latter, population growth, it's the one issue that unites all others.

We are looking at a global population of nine even ten billion people by 2050 – every third person in this room would have to share a seat with someone else to accommodate that! The challenge isn't just about the number of people – it's also about where they'll be and what they'll be doing and expecting.

This leads me on to what I think is the grand challenge – urbanisation.

SLIDE 3: The grand challenge

Urbanisation is the grand challenge because of the drive towards city living and what we need to do to accommodate that...it means thinking about energy needs, water, waste, the environment.

Some figures that bring this home:

- UN report from autumn 2013 suggested 86 per cent of people in the GCC region would be living in cities by 2020 (global figure is around 56 per cent).
- It means I have probably underestimated the effect on this room – you all might be sharing seats by 2050 *and* we'd have to have a bigger auditorium / we'd have to upgrade the air-conditioning *and* think more carefully about how we'd all get here because of potential transport congestion.

Dealing with these challenges, as I've stated, cannot be done on a sector by sector basis. Solutions must be holistic – if they're not they will not be sustainable.

I've spoken about the challenges the world is facing – just focusing on the UK and the UAE we can see some obvious areas that need addressing...let's look at energy.

Both regions have exploited fossil fuel reserves to propel economic growth over many decades. Equally both know the future will require a more diverse approach because energy policies have to be sustainable long term. Both regions recognise that there isn't going to be a single solution – we need to keep utilising our natural resources – oil and gas, coal – but doing it in a more efficient way.

One of the ways we are doing this is through enhancing existing energy infrastructure used to exploit natural resources. Significant cost efficiency in the offshore oil and gas industry is realised by extending the use of existing infrastructure allowing marginal fields to be developed economically. As we seek to learn from each other, let me share a few examples which demonstrate how we are doing this.

SLIDE 4: Efficiency through life extension

A common way of visualising asset degradation is the bathtub curve which shows the increasing asset risk over time. By drawing on 40 years experience of asset integrity management we can *safely* anticipate and manage repair of age related defects, allowing continued use and development of ageing infrastructure.

Atkins' experience plays a key part in updating international codes and standards allowing the industry to benefit from technological advances. This includes developments in wave loading, foundation behaviour and reliability assessments to quantify asset integrity risk.

Atkins is leading the industry in combining detailed structural understanding with real time structural monitoring, to demonstrate safety of personnel on board for degrading assets. A major platform can be key to the exploitation of many subsea fields.

Atkins' innovative approach to life extension enables operators to get the most oil and gas resource out of the development/field before the infrastructure fails. Extending the life of a key hub platform negates the need to build new infrastructure to exploit this resource. It ultimately reduces the energy and investment needed to put more steel into the sea (and of course to later remove it) and brings us closer to our low carbon ambitions.

EXAMPLE ONE

An example application of our innovative approach combining known techniques and increasingly sophisticated analysis to extend the safe operating life of an asset is the recent upgrade of the Claymore Platform. Following recent detailed assessment by Atkins and upgraded facilities, Claymore is expected to operate for over double its design life.

EXAMPLE TWO

To support the transition to more efficient fossil fuel generation plants, Atkins is supporting clients in converting existing open cycle gas turbines to combined cycle. This substantially improves the carbon efficiency of generation. Alongside efficiencies in our most established energy streams we need to bring new resources on line - nuclear *and* renewable.

EXAMPLE THREE

I can point to what is being done at Masdar, the hosts of next week's World Future Energy Summit – a shining example of clean tech ambition. At Masdar - technology rules - electrical transport fleets, computer controlled buildings, smart infrastructure and clean energy. Investment is pooling behind these new technologies, energy in particular, with around \$1.7 billion under investment in international renewable projects.

This investment has had global impacts. For example Masdar's support for the London Array which is feeding power to half a million British homes. This is an example of how we are exchanging knowledge across nations – the shared objective for this Group.

It's interesting to note the impact of schemes such as the London Array are having – the latest figures (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266563/press_notice

[dec_13.pdf](#)) for UK energy consumption show a record amount of renewables generation – now standing at over 37 per cent of total low carbon generation.

At the same time the production of coal fell sharply by 32 per cent following closure of mines; oil fell by 7 per cent and gas fell by 3.8 per cent. But it's not only about efficiency in the way we generate and transmit energy – it's also about efficiency in the way we use what we're producing and think about how we save it too.

In the US energy sector they are analysing long term peak demand needs vs customer acceptance of service adjustment: smart metering can enable this process – smart avoidance of peak demand. We're increasingly seeing the use of building management systems in commercial properties to monitor and help cut energy use. Let me share an example of this.

SLIDE 5: Building performance

What these systems do is provide much smarter, more accurate real time reporting of how a building is performing. This helps an asset management team know if a building is performing as it should and pin point problem areas.

Much of it is now wireless so installation costs have dropped. We have seen these alone save 15-20 per cent of a building's energy performance along with other proven system upgrades around heat and cooling systems, lighting and ICT upgrades. In one scheme we have helped to invest £200 million on 9000 energy efficiency projects in over 600 organisations to save 35,000 tonnes of CO2 PA and £750 million in avoided energy costs because of these upgrades of inefficient systems.

The model is interesting because the capital costs get covered by the energy savings. The paybacks can be phenomenal and the technologies proven. Also the construction materials we're using are having an impact. Take phase change materials – these are increasingly being used in insulation panels. During the day the panel's bio-based interior melts, absorbing heat and helping keep the building cool. In the evening the material re-solidifies and releases its energy back. It means temperatures remain fairly constant.

Tests in London have suggested energy savings in an average commercial building of between 20-70 per cent. These creative ventures are just a few examples of things the UK/UAE can share expertise on, can jointly invest in – it is a wonderful partnership.

This is all about being creative - and as one of history's most eminent people, Albert Einstein, said: "Creativity is contagious. Pass it on." I think we're doing exactly that – but creativity on its own is not enough. So, we have looked at how we can learn from projects around the world, but now let's look at

how we can be more holistic in our approach, by ensuring we have a vision for what we are trying to achieve.

SLIDE 6: Vision

It's up to us to create the future we want. It is about creating holistic policies that deal with challenges in way that promotes growth but not at the expense of our long term success – whether that is measured in financial terms, people terms or the environment.

Here in Abu Dhabi – there is fantastic vision in solar energy. Did you know the amount of solar energy that bounces off the Earth each year exceeds the total amount of energy humankind is using by 20,000 times...but capturing enough of it needs invention.

At Masdar the Institute is looking at how to use sand to store more solar energy by running the sand grains through a focused beam generated by a solar array (<http://www.thenational.ae/uae/technology/sand-may-be-the-answer-to-storing-solar-energy>). The sand would then be stored at around 1000 degrees Celsius in an insulated chamber and later released via the insertion of a heat exchanger.

Globally – there is vision in nuclear fusion tech. In an even more ambitious programme an international collaboration of countries is backing the ITER nuclear fusion experiment in France. I mentioned this earlier. The project is aimed at recreating the way the sun generates energy but doing it at even greater temperatures! The reactor core is expected to reach 150 million degrees Celsius, ten times hotter than our sun, with first energy generated early next decade.

This is vision – demonstrating fantastic ambition to meet future energy demand sustainably. It's not just about projects to grab the headlines – the core infrastructure has to be right too.

We saw in 2012 the brownouts in India where 700 million people were left without power as their grid struggled to meet demand and eventually fell over. In Alberta, Canada, the regional electrical system operator instituted rolling brownouts as six generating plants failed during peak time in a heat wave. Even in the UK there is concern that the National Grid may be stretched in winter-time due to the closure of coal-fired power stations being forced by European Union pollution regulations.

Dealing with challenges on this scale means you must have a long term vision. Many countries have exactly this – I will highlight the excellent UAE Vision 2021. It is a multi-dimensional vision – with objectives related to national identity, the economy, education and health. This is hugely ambitious and the complexity of the challenge requires multi-tier partnerships.

SLIDE 7: Partnerships

Partnership takes many forms but I will pick on three:

- **Firstly, political** – achieving a vision needs governments to be ambitious and drive targets creating momentum for change. ENEC is a good example here in the UAE – where a rational analysis of the facts led to the conclusion that from economic, environmental and societal viewpoints, a peaceful nuclear power programme was the correct way forward to meet the long term energy needs of the UAE. This was then subsequently enshrined in UAE policy.
- **Secondly, there are technical delivery partnerships** which can be of many different levels – sometimes assisting with technical expertise on a single project, a series of projects, a single area of policy – from a city-scale to a national even international scale.

We're working with the Scottish city of Glasgow developing a state of the art Recycling and Renewable Energy Centre that will handle more than half the waste the city generates every year and the burning of that waste will power the equivalent of 22,000 households.

Atkins has also been advising on waste characterisation, fuel modelling, site selection studies, transportation and environmental permitting for TAQA's energy from waste project in Abu Dhabi. We also see technical partnerships on an international scale which is what this Energy Working Group is all about.

Many of you in this room will know that through our joint venture with French engineering consultancy Assystem, ntriplea, Atkins has been providing an independent technical assessment of the programme which will deliver four new nuclear fission reactors under the leadership of the Emirates Nuclear Energy Corporation (ENEC). Our advice has been helping to inform the investment decision of the private lenders – also some very important partners!

Our involvement from these early stages will foster even more sharing of knowledge and best practice between the UK and Middle East over the long term. The ITER project (mentioned earlier) involves an international collaboration on a truly grand scale – bringing together scientists and engineers from all over the world to try and harness the energy produced by the fusion of atoms.

Sharing such a broad spectrum of engineering expertise and experience across cultural and political boundaries is exactly the combination of vision, partnerships and technology we are talking about. As a global community, more and more we recognise that no single nation can face the challenge to decarbonise and increase energy supply alone.

- **Thirdly, partnership through people.** Building on last point about society – move on to final strand – the people. We need to make our nations, our cities, our energy grids work for the users. There's an increasingly open dialogue on energy policy – some of it is controversial.

In the UK the Government is looking at large scale fracking and only this week we heard that French organisation Total plans to start fracking in the UK when it is banned in its home territory of France. In nuclear they're also agreeing financial support deals with potential new build nuclear energy providers – EDF and the Horizon consortium.

With both sectors there is an argument to win with the public – convincing people it is a good idea to do this. These arguments cannot be won by political rhetoric alone, it needs experts to interrogate the plans, providing people with objective evidence. Winning the public argument is absolutely vital in order to give the political leaders the license to be ambitious!

SLIDE 8: Technology, tools and techniques

Finally let's look at technology, tools and techniques. Technology is obviously advancing at a rapid rate – it helps us and places a burden on us. I have already mentioned a few examples of existing technologies and infrastructure that are being refined to make them cleaner and or more efficient. Here are a few more.

Another example of enhancing the operating efficiency of our energy infrastructure through technology can be found in the flow assurance work we do. All oil and gas operators will ask what can we do to get more production with limited changes to this facility and what of the 5 years ahead?

Our software technology, MEASCAP, enables better gathering and interpretation of data than traditional debottlenecking studies which enables more efficient decision making for the repair or replacement of infrastructure to handle future flow demand.

In the UK, the Government's Department of Energy and Climate Change turned to Atkins to provide technical advice on the economic viability of a geothermal energy programme. We are advising on their energy storage programme where they are funding initiatives to provide grid scale energy storage solutions – a key to smart grids of the future.

Another lesson to be learned is how the UK Government is investing in new technology. The Department for Energy and Climate change has funded a number of technologies – one example. By delivering 300 smart batteries into homes, a 0.5MWh storage system is created, allowing electricity to be stored at times of low demand (or at times of high generation from intermittent sources, such as wind), and utilised at times of high demand.

Here in the UAE, Siemens is working with the Masdar Institute to develop new carbon capture and storage solutions and just last week Adnoc and Masdar announced their plan to break ground on one of the Arabian Gulf's first commercial carbon burial projects next year.

In the UK, Atkins has been the technical and commercial advisors to the UK Government working with academia and industry for its £1 billion Carbon Capture and Storage (CCS) Commercialisation Programme competition.

And finally, it's not just what you build but it's also about how you build it – Building Information Modelling (BIM) is already a corner stone of some of the UK's most famous projects: including a new metro in London - Crossrail, the proposed High Speed 2 line and the new Hinkley Point nuclear reactor project.

On Hinkley Point C, the biggest carbon/energy/cost negative impact it could have, as with any large infrastructure CAPEX programme, is by being late. BIM, through a 4D model can show the entire construction process chronologically and help to make it more efficient, thus helping to avoid problems that have occurred on nuclear new build projects in other regions, where designs were very difficult to construct in practice. The complete shift to BIM is most likely the next step in technology to realise the energy saving ambitions for the nuclear new build in the UK.

SLIDE 9: The journey towards smart cities... Vision / Partnerships / Technology

So, we have considered the challenges we face and how we can learn from existing projects around the world, working together to ensure information flow between the nations in which we work. Our shared objectives for this Energy Working Group.

We have explored how we can realise a vision to plot the correct course we should take and how innovation in technology is essential to achieve this. How fitting it is that we sit here today as part of the Energy Working Group that we can reflect upon and be sure that we are acting upon the words of HH Sheikh Zayed Bin Sultan Al Nahyan who said: "I had many dreams. I dreamt of our land keeping pace with the growth of the modern world."

Let me thank you for your attention and now open the floor to questions.