



# Future hydrocarbon resources: innovations, technology and opportunities

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## Introduction

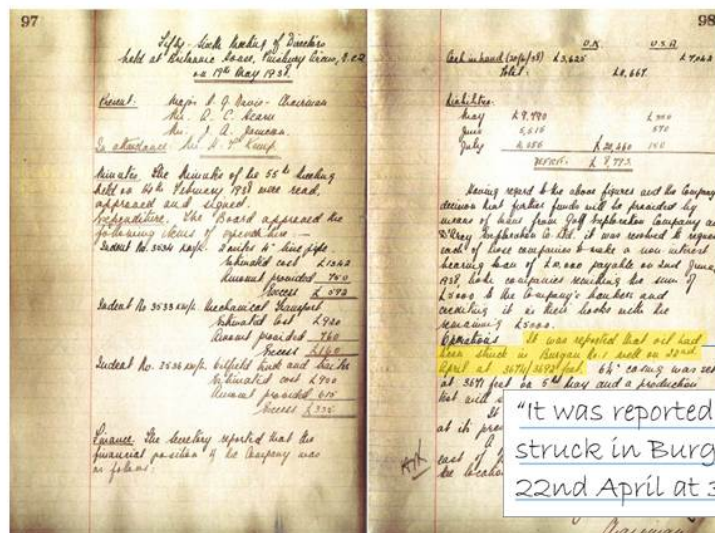
Your Highness, Your Excellency, ladies and gentlemen.

Good evening everyone.

It is great to be back in Kuwait, and to be among good colleagues and firm friends.

It is also a pleasure to be a part of this great gathering of our industry.

### Kuwait, 1938



"It was reported that oil had been struck in Borgan No. 1 well on 22nd April at 3674/3692 feet."



I thought I'd start with something that I found really interesting. It's from a very old book.

On the screen is the original record of a meeting of the directors of the Kuwait Oil Company in May 1938.

The section highlighted is where they noted that oil had been struck in Burgan.

It's a copy of a treasured record of our long-term commitment to Kuwait, having been a partner right back at the start.

It's a reminder of the long history of our industry and its resilience – and how we have adapted to changes and challenges over many decades.

Today we're all focused on the price of oil – but when I think about it, this is at least the fourth oil price collapse I have seen in my career. And while they create real stresses, the industry has adapted and recovered each time.

Crashes come when demand is too low or supply too high – and today's is a classic case of oversupply.

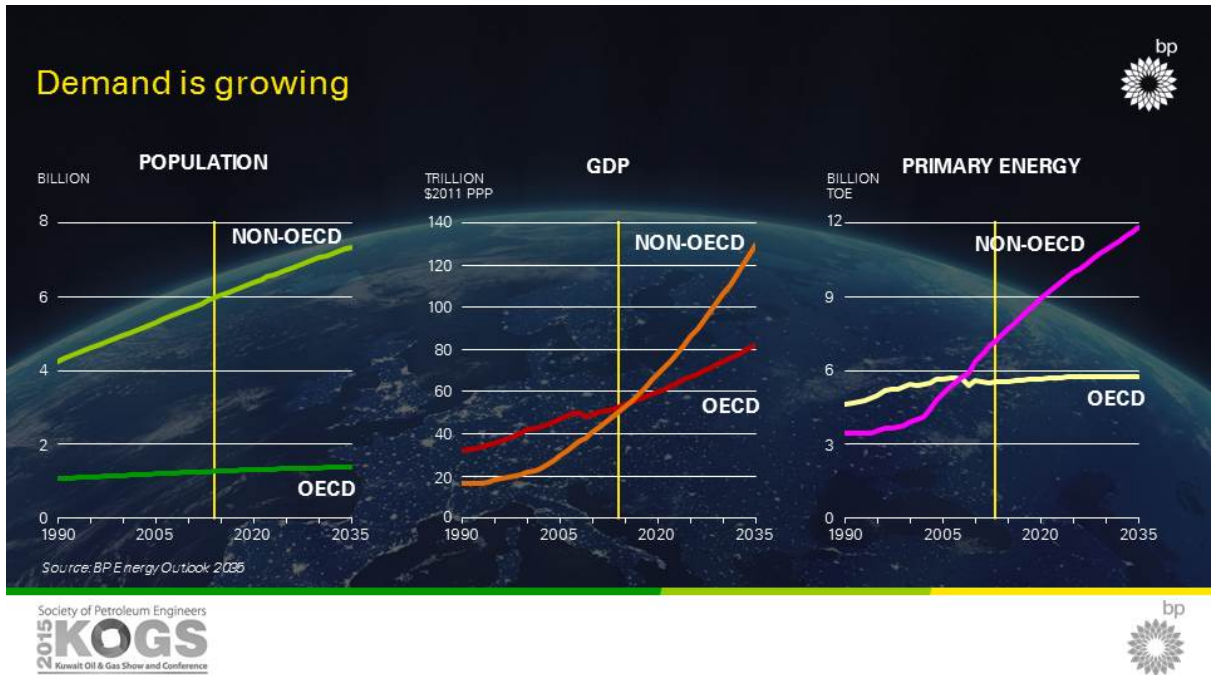
It has its origins in the shale and tight oil revolution in the US.

And the recent increase in OPEC production – particularly in Iraqi production – has added to the excess supply in the market.

Supply and demand will eventually come back into balance, but that could take some time and will still leave the market with inventories at excessive levels that will need to be worked off.

The cycle will turn, but there is also a structural shift in the energy mix taking place – so we should be prepared for a return to the norm of volatility – and for a future with recurring periods of low prices.

That means we need to demonstrate rigorous cost discipline – and of course capital discipline – as we look to generate value in a lower price environment.



What is clear is that oil and gas will continue to play a big part in meeting people’s needs for decades to come.

Looking at the long term picture, we expect global demand for energy to continue to rise substantially.

In BP our economists forecast that annual demand for energy will increase by about a third over the next two decades – driven by growth in populations and economies.

That energy growth is equivalent to about two-and-a-half times the entire annual current energy production of the Middle East.

But there are plentiful resources in the ground in this region to help meet the rising demand. And the opportunity to recover more of the oil in mature reservoirs represents an enormous resource.

With the age of easy oil behind us, there are new challenges to recovery.

However, I believe here in the Middle East we have the partnerships, the technology and the track record to meet the challenges.

And that transition to a new future from an historic past is what I’d like to focus on now.



## Kuwait's oil history

Indeed, the 80-year history of oil in Kuwait is one of giant fields, strong partnerships and constant advances in technology.

Actually, one of the most important technologies available to the early explorers remains a prized asset today.

It was nothing less than the trained eye.

Burgan – the biggest sandstone reservoir in the world – was discovered by geologists advising where to drill having spotted oil seeps in the desert.





Progress in seismic survey technology

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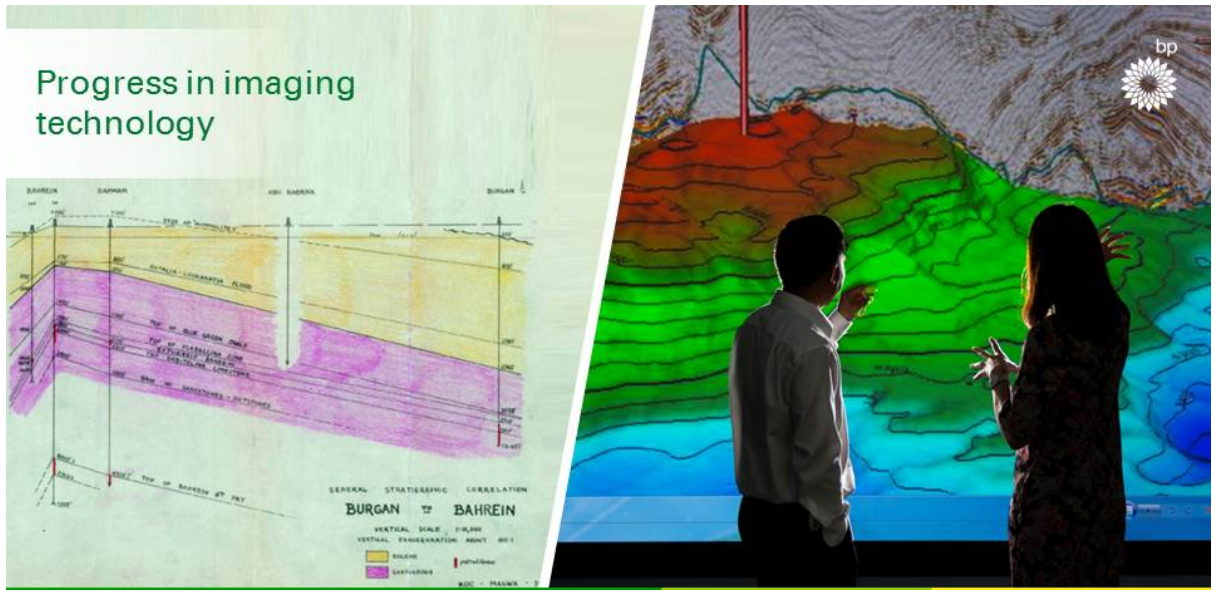


Since those days we've seen technology taking massive strides forward.

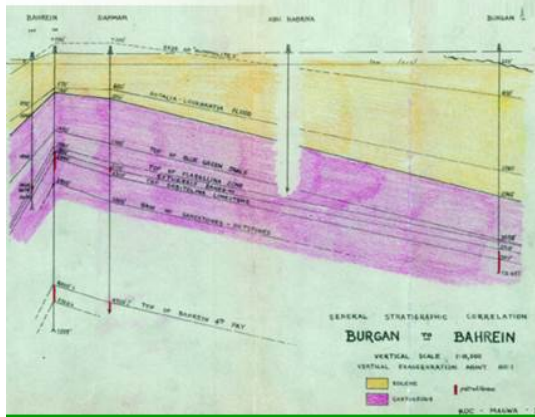
The technology used for seismic imaging has been completely transformed...

...from the slow and laborious process of drilling individual shot holes...

... to fleets of trucks with vibrating plates moving rapidly across the landscape.



Progress in imaging technology

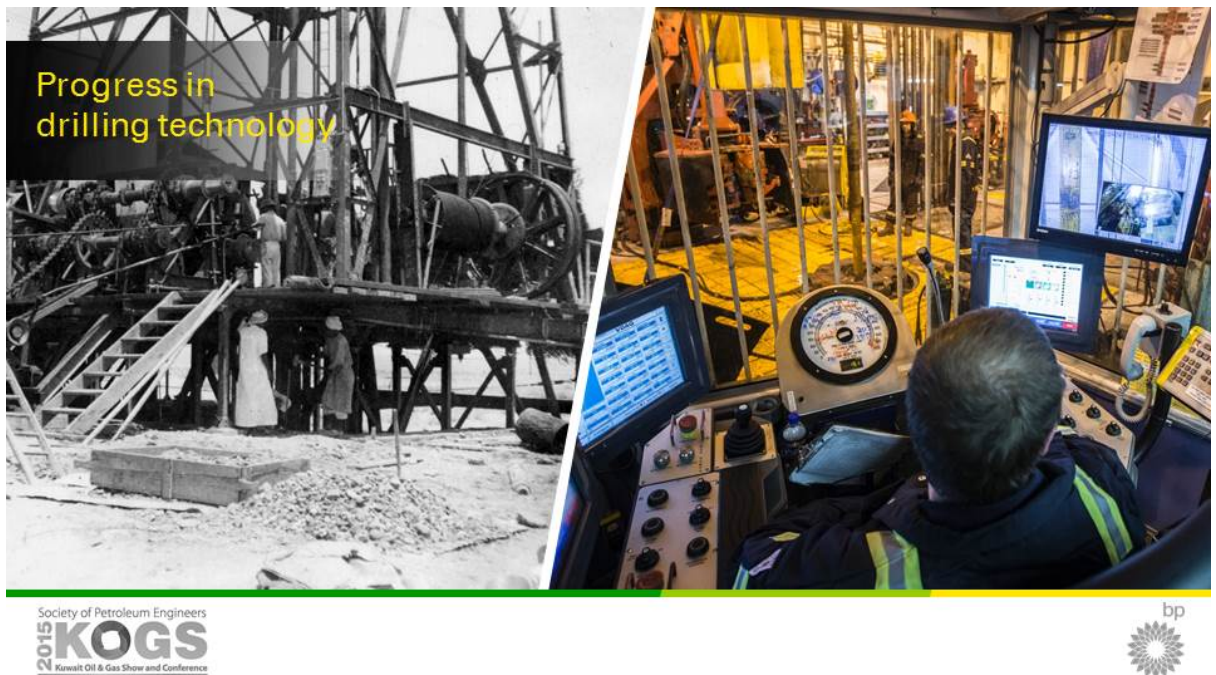


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We have seen the data created by seismic imaging transform our understanding of the subsurface.

The image on the left was hand-drawn in the 1930s, while the one on the right shows our geologists today studying a high quality 3D-image from some of our latest seismic surveys.



And we've seen drilling technology transformed...

...from simple but effective vertical wells...

...to highly sophisticated horizontal or multilateral wells guided by digital sensors recording data in real time down the hole.

This kind of progress in technology means that the Burgan field and Kuwait can continue to rise to the challenge of world energy demand.



I was here back in 2009 for the celebrations to mark 75 years of the Kuwait Oil Company and I expect there will be preparations in due course to celebrate 100 years and then the 150-year anniversary for this great company.

Kuwait's mature oil fields have been consistently growing production towards 3 million barrels of crude a day.

That translates into four in every hundred barrels worldwide coming from this one country.

And they are some of the lowest-cost barrels anywhere in the world.

That is a distinct advantage in any environment – particularly today's.

But it is also important to look ahead – and it's true to say that all today's mature fields – in Kuwait and elsewhere – are at a crossroads.

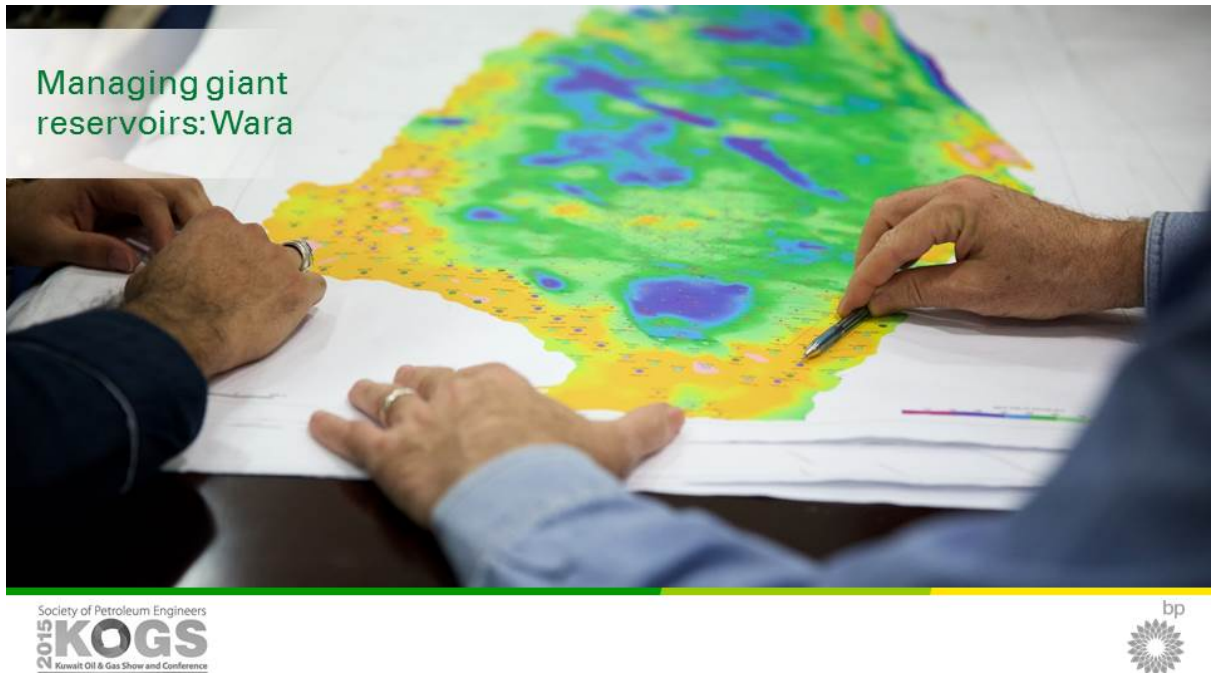
Resources are abundant, as I've already said. But the world is changing.



The era of 'easy oil' is at an end.

Back in the 1930s one of the biggest technology challenges on the Burgan field was how to manage the high pressure of the Wara reservoir.

Today's challenge is coaxing oil out from a mature field after the pressure has fallen.



## Kuwait's oil potential

We have been down paths just as challenging before.

Each time a solution has been found in technology, innovation and expertise – and in the partnerships that can harness those capabilities.

I am sure the same approach will ensure mature fields in the Middle East continue to deliver through the 21st century.

Why am I sure?

Because in BP we have seen it happen already.

Over the past 40 years we have worked in giant fields around the world and seen how technology and capability can develop when we set our minds to unlocking the resources.



Conventionally, it was assumed that only about a third of a reservoir's oil was accessible – with two-thirds left in the ground as too difficult to produce.

Those assumptions about low recovery rates are now being overturned.

For example, in 1977, the estimated recovery from our super-giant Prudhoe Bay field in Alaska was expected to be less than 40% at the end of field life.

It has already passed 40%.

In fact, we are expecting to recover more than 60% of the initial oil in place.

Essentially Prudhoe Bay's period of 'easy oil' ended around 25 years ago and since then it has been a hugely successful test-bed for enhanced oil recovery.

We have developed many highly specialized gas and water injection techniques in our own research facilities and in partnerships with academia.

That has been backed up by advances in 3D and 4D seismic imaging – to the point now where the technology can offer not just accurate images of the subsurface – but can track the movements of oil, water and gas through the rocks to optimize recovery.

This process is now being further accelerated by the power of so-called 'big data'.

Our supercomputing centre in Houston has the capacity to perform nearly four-thousand-trillion calculations a second.

That enables geoscientists to do in single day what would have taken then four years only a decade ago.

There is a particular advantage in transferring this technology and knowledge to fields such as Burgan or Rumaila or Zakum in the Middle East – and it is one of scale.

In the case of the Wara reservoir, a BP team has been working with KOC to help start-up a world-class waterflood project.

The team have approached this in two ways.

They have used techniques that increase production from existing wells, such as matching pump designs and pressures to reservoirs and developing new water injector stimulation treatments. This has already delivered significant new production.

And the team has also reviewed plans for new wells to make sure they are hitting the sweet spots in the reservoir.

By listening to the challenges, gaining an understanding of the problems, and reviewing existing activities, the partnership is helping to identify and execute compelling solutions.



## Potential across the Middle East

Technology and partnership make a great combination. It's a principle that can be repeated, and adapted, across the whole of the Middle East region – and the whole globe. Indeed, it's happening already.

In Iraq – on the giant field of Rumaila – we have been working in a partnership with the South Oil Company and PetroChina.

The focus has been on reservoir management in general and excellence in drilling in particular.

Together we've just completed the 200<sup>th</sup> new well over the past five years. And we're proud of the fact that production has risen from less than a million barrels a day in 2010 to 1.34 million last year.



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In Oman – on the giant tight gas field of Khazzan – we have been working in a partnership with the Oman Oil Company.

By using state-of-the-art imaging technologies we can identify reservoir sweet spots. And by deploying directional drilling and hydraulic fracturing technologies the partnership has been able to produce commercial volumes of gas from some of the world's oldest and toughest sandstone – rocks that are as hard as granite.

We are currently developing the Omani workforce to build the capacity to drill 300 wells over the next 15 years, and produce enough gas to meet a third of the country's needs.





In Abu Dhabi – on the giant fields of Zakum and Umm Shaif – we have been working in a partnership with the ADMA-OPCO that goes back for decades. We currently have a team of over forty petro-technical secondees helping to maximise oil recovery over the life of the field.

A common factor in all of these examples is the need to balance current demands with long-term aspirations.

It's something we have learned a lot about as an industry – and continue to do so.

And we estimate that each 1% improvement in recovery delivered across all of the conventional oil fields of this region would equate to between 16 and 20 billion barrels of oil equivalent.

Or to put that another way – every 1% is like discovering a whole new super-giant field.



## Conclusion

I'd like to finish by going back to the point where I started – with the partnerships that were formed at the beginning of the industry.

The nature of these partnerships has changed over time.

In the early days, international oil companies took a lead in the discovery and production of oil in places such as the Middle East.

Stewardship then passed to the national oil companies. Meanwhile, IOCs learned new skills and developed new technologies.

Today – in the face of lower prices and tougher recovery challenges – new partnerships can secure the future – partnerships that share world-class technical expertise and world-class local capabilities and resources.

The jetty that you can see on the left-hand-side of this slide is the North Pier at Mina al Ahmadi in the 1960s.

Around that time, ships like the *British Adventure* used to transport Kuwaiti crude from Mina al Ahmadi to the rest of the world.



The *British Adventure* was BP's first supertanker, weighing in at about 30,000 dead weight tonnes.

Today, supertankers ten times the weight of the *Adventure* are doing much the same job of transporting Kuwait's oil and gas around the world – but on a far bigger scale.

With oil and gas becoming more difficult to extract, and low prices putting pressure on costs, the challenges may have grown.

But so has our ability to meet the challenges of today and the demands of tomorrow.

We can do that by combining the complementary strengths of NOCS and IOCs to the benefit of countries around the globe.

Speaking for BP, we have a long history in the Middle East – and a deep commitment to its future as one of the world's energy heartlands.

We were here at the start.

We are proud to be here today.

And we look forward to working with you for many decades to come.

Thank you



Bob Dudley  
Group Chief Executive

