CAN FOSSIL FUELS AND GREEN ENERGY WORK HAND-IN-HAND?

AN INTERVIEW WITH PROFESSOR DR. GIOIA FALCONE, HEAD OF THE OIL AND GAS ENGINEERING CENTRE AT CRANFIELD UNIVERSITY

Gioia Falcone is currently Professor and Head of the Oil and Gas Engineering Centre at Cranfield University. Gioia holds a Laurea Summa Cum Laude in environmental-petroleum engineering from the University Sapienza of Rome, a M.Sc. degree in petroleum engineering from Imperial College London and a Ph.D. in chemical engineering from Imperial College London. Prior to joining academia, she worked with ENI-Agip, Enterprise Oil UK, Shell E&P UK and TOTAL E&P UK, covering both offshore and onshore assignments.
Along with being actively engaged with the Society of Petroleum Engineers (SPE), she is also one of the 21 members of the United Nations Economic Commission for Europe (UNECE) Bureau of the Expert Group on Resource Classification, and of its Renewable Reserves Taskforce. She is the appointed Leader of the International Geothermal Association (IGA)/UNECE working group for the development of geothermal specifications for the UNFC-2009.
She has co-authored over a hundred scholarly articles and one US patent, edited the 2012 Multiphase Flow Metering SPE Reprint Series "Getting up to Speed" and co-authored the 2009 book on Multiphase Flow Metering, published Elsevier.

Rachael Simpson

Q: Tell me a little about yourself and your background in oil and gas.

I am a petroleum engineer by background, and by that I mean by academic training and also by industry experience. I started working in the oil and gas industry back in 1999, where I gained experience working in the North Sea, as well as onshore, with different majors. I have remained in the oil and gas sector, although I decided to move the 'other side', meaning academia, in 2006. Whenever people discuss oil and gas, they invariably end up talking about the United States of America. In this respect, I am no different as I headed west, to Texas, to one of the largest universities in petroleum engineering in the world (Texas A&M), and from there one thing led to another and now I am here at Cranfield University.

Q: Yes, you've recently been appointed head of the Oil and Gas Engineering Centre at Cranfield University – can you tell us about what you will be working on there?

I will be leading the oil and gas engineering centre, where I will lead a team of academics and specialists, ensuring that they have a platform from which to give their best. In parallel, I will be developing new research and activities in the area of petroleum engineering, and also at the interface with renewable energy resources, as I believe that's going to be the future.

Topics that this centre has already been working on prior to my arrival, and themes which I can bring, include multiphase flow systems, flow assurance, computational fluid dynamics, and production optimisation. I want also to expand in the areas of liquid loading in gas wells, and mature fields, which are very important topics particularly in regions of advanced production, such as the North Sea. In addition, we will be working on subsea engineering, automation of sensing and instrumentation, and geothermal energy exploitation.

Q: What makes Cranfield so well-placed for this research and development?

I believe that Cranfield definitely offers something special, and I'm saying this as someone who has worked at several other universities in Europe and the USA. It's because Cranfield is so research-focused, not just fundamental research, which is well covered of course, but more specifically applied research that serves the industry and delivers solutions. I'm an engineer, and engineers are always seeking solutions, so when I came here and saw the amazing facilities of industry scale, and saw people trained and focused on delivering, I knew straight away that Cranfield was a bit different.

Q: You have a strong background in geothermal energy systems– could you give an overview of what geothermal energy is for any readers that may be unfamiliar with this?

My introduction to geothermal energy was a case of 'jumping in at the deep end', as I'm a petroleum engineer and I was happily working for the oil and gas industry. Yet, it is normal in an academic environment to look around for topics where your skills may be applied, and at the time in question, there was a major push towards carbon capture and sequestration (CCS). Also, at Texas A&M where I was working, there was a growing interest in geothermal energy engineering.

CCS and geothermal energy seemed natural areas for me

to develop my expertise as they both have to do with the subsurface. With the former, we want to capture the CO_2 at the surface and inject it underground in what we call a reservoir porous medium. With the latter, we are dealing with "geo", which is the geo-source, and we strive to produce the heat trapped underground and bring it to the surface. The processes involved are very similar to those we employ in the oil and gas industry. For example, we are dealing with the subsurface, the flow of fluids through the underground media, and this flow arrives all the way to surface via wells that are drilled like those for oil and gas production. Having brought these fluids to the surface, we can process them to extract the heat, which is a product we can sell, either for heating or as electricity or both.

When I looked more closely at this global picture from reservoir to surface, I realised that my background in petroleum engineering was an advantage. Yes, there is more to geothermal processes, in that the thermodynamics are a bit different and resource recharge is complex to predict, for example, but we are still dealing with water, steam, some impurities, changes of phase along the way, from bottom to top. So I was able to quickly get up the learning curve and use my skills as a petroleum engineer in the area of geothermal engineering.

Q: Is there scope for an interface between new and existing O&G and geothermal systems? If yes, how can you see this technology evolving and developing?

This is something that I find fascinating, and which may represent a future avenue for mature oil and gas systems. When we produce oil and gas, we are not producing just oil and gas, as water is also being co-produced most of the time. This water is typically from the aquifers that lie beneath or is surface injected water, which is used to increase recovery efficiency by maintaining reservoir pressure and sweeping oil towards the producing wells. These fluids arrive at the surface at a certain elevated temperature, because they are coming from below the earth's surface, so we have hot water associated with the oil and gas produced from petroleum systems, and we often have lots of it. We can consider this abundant hot water as a "geothermal" product that is co-produced with the hydrocarbons. So why not use it?

This is not a new idea, but it is still in its infancy. There have been a few pilots around the world, where small test plants have been able to produce electricity from this associated hot water. So could this concept become an interesting business model for an oil company? It all depends on its commerciality. As an oil producer, I will have sunk capital investment already in drilling my wells and installing processing facilities onsite, so I would have access to a new potential income stream from the co-produced hot water. I could sell electricity by extracting the heat from the water; heat that is currently wasted. Alternatively, I could use the potential income to reduce my normal operating expenditure, by generating my own green electricity, rather than buying electricity from the grid to run my facilities. An added bonus would be if the government encouraged such schemes by offering tax incentives to reward energy efficient oil producers, who are being 'good boys', taking steps to reduce their carbon footprint.

Q: I assume that geothermal energy has its own particular challenges and problems much like any form of energy available to us. Is there anything we have learned from the oil and gas industry that we can apply to geothermal energy systems to improve efficiency etc.?

Absolutely, and vice versa. In the oil and gas industry, we are now able to exploit the gas and condensate from deeper high pressure high temperature (HPHT) reservoirs. This expertise and knowledge from the oil and gas sector is directly transferrable to meeting the challenges of developing geothermal systems, which are typically at greater depths, meaning elevated pressures and temperatures.

Another important area is deep drilling. As the oil and gas industry seeks to exploit ever deeper resources as the shallower 'easy' resources have been depleted, so the geothermal sector has also focused on going deeper. Increased depths mean a much hotter and more hostile operating environment, as we are getting closer to the earth's core of the earth, so deep drilling is a real challenge for both sectors. Drilling deeper forces you to go for slimmer borehole sections; you need to spend a lot more money as you stay on site longer, and you will encounter hard rock formations that consume drill bits very quickly. These are just a few of the transferable areas of expertise from oil and gas to geothermal.

Yet the geothermal world has also led way when drilling in urban environments, showing tact and innovation in its operations in close proximity to the public, with advances in compact modular drilling rigs and noise reduction technologies.

Q: Can you tell us more about the United Nations Economic Commission for Europe (UNECE) Bureau of the Expert Group on Resource Classification – how you are involved, the work and purpose of this group etc.

The purpose of UNECE is a noble one, in my opinion, as it is all about the sustainability of energy. Its premise is that we need to make energy accessible to the world and to ensure that everybody has the same access to energy, independently of their location.

UNECE is developing standards and a framework for comparing, on equal terms, energy resources of different types. For example, consider country A, which would like to understand how many of its oil and gas resources are yet to be produced. Country A would also like to know how much wind energy it could produce, how much geothermal energy it could produce, and how much solar energy it could produce. The government of country A, for security purposes or for independence purposes, could then take a portfolio overview and announce "this is my energy portfolio". Although this concept of resource specification is well established in the mining and petroleum sectors, it is not that well known, nor accepted, in the renewables sector. Yet, being able to compare fairly between these sectors would actually facilitate investment and help prioritise where the money should go. It would also address the questions what energy is available now, and what energy could be available if more R&D were done.

It was completely serendipitous that I got involved with this group. I was presenting at a geothermal conference in Germany just after moving there, and there was someone from UNECE also giving a talk. They heard my presentation and said "Wonderful, we are looking for somebody in geothermal!" and that's how I got invited. UNECE is totally voluntary; we don't get paid for our services, but if funds are available, I can sometimes claim back my travel expenses. Hence, we put a lot of our own time into delivering these documents. You get to know amazing people, work on high level problems, and you have a chance to make a difference.

Q: You mentioned renewable energies such as wind and solar - do you see a future for O&G technologies when so much pressure is on governments and energy providers to move further towards these "green energy" options? Do you think the energy industry can ever be fully separate from oil and gas or should it be hand-in-hand with renewables?

I think the latter for sure. The two sectors can and should co-exist and should proceed hand in hand, and learn from each other. I don't envisage a sudden change to green energy and I think this is now accepted knowledge. Many countries have proposed deadlines of three, five or ten years by which to go fully green, yet these deadlines have already passed and the change hasn't happened, due to recognised challenges. We know that electricity from renewables tends to cost a lot more than electricity generated from conventional energy sources. There is a growing acceptance that renewables are in an extended transition period, and there is a realisation that we have to be more efficient in the way that we use our conventional energy resources. We have to be cleaner and reduce emissions, and this can be done. The oil and gas industry hasn't finished doing its homework, and we certainly don't want to have a Macondo number two. One would like to think the oil and gas companies are able to go into sensitive areas without making a mess, and they do need to be there to provide time for the use of renewables to pick up. If you start thinking about solutions like the one I mentioned earlier, using geothermal energy from oil and gas systems, who knows how things may evolve without any dramatic demise of the petroleum industry.

There are still avenues in the petroleum sector that we haven't fully explored yet, because (at the moment) R&D is limited as the costs are still too high. I could mention gas hydrates, for example, of which there has been a lot of talk, but has resulted in very few pilot studies, with one site test actually producing.

Q: So it's a case of needing more investment then.

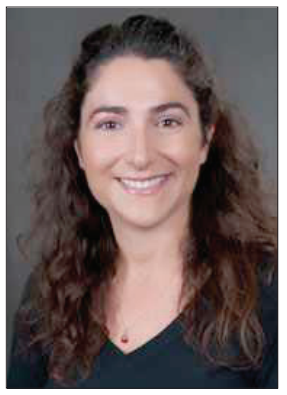
Of course we need much more investment in the energy sector, but in a transparent way. Trying to compete by saying, "Give the money to me, not to them", "me" being oil and gas or renewables, is not a win-win situation. I think it's important to say in a given location, "This is what you have, and this is what you should give priority to". Change the country, change the geopolitical situation, and that will change your list of priorities. Diversity is key, and enhancing the variety of energy resources and corresponding solutions is crucial, in my opinion. Offshore, you have one situation, whereas onshore you have another; in a hot country, some solutions work better than others; in a cold country, with environmentally sensitive issues, you may need to consider something else. Not every place is the same, which in my view, is the main problem. At a country level, governments tend to look for the solution for the entire country, which can be thought of as the fabled silver bullet, but this approach is inherently risky. If a government pushes an entire country in one direction, towards a single solution, what happens if that fails?

Q: I'm sure you're aware that the oil and gas industry in the UK is experiencing some difficulties, especially up in Scotland. Do you think the UK/worldwide O&G industry could make better use of newly emerging engineering methods and technologies? Is there a gap in the market that could be exploited more beneficially?

First of all, I'd like to say that I've travelled extensively and this problem is not unique to the UK. I think it's a classic case of an outdated energy policy being perpetuated until it's too late. The question is about being open minded to what the rest of the world is doing, and I do believe that the UK is open minded.

The UK has been a pioneer in the offshore world, and it's climbed a steep learning curve in a relatively short time. From the first platforms in the seventies, to the present day situation, where the UK appears almost resigned to giving up, decommissioning its fields and infrastructure, closing down and walking away, and all within a span of only 5 decades. If you think about how much has been learnt in those relatively few years, the amazing technology breakthroughs that have happened, then why should we underestimate our ability to reinvigorate the North Sea? I think we can come up with new solutions to revamp what we have, to breathe new life into the remaining ageing infrastructure, by working closely with the structural integrity people. We must keep HSE as a priority, which is an increasing challenge in the current low oil and gas price environment. Subsea systems can be worthwhile, as long as we focus on monitoring, inspection, automation of these processes, and by making the systems more affordable – that's what has to happen. Subsea technology must become cheaper and more flexible, so there has to be more openness to swap experiences and knowledge. The UK government needs to keep pushing for this collaboration to happen or it never will. For example, the UK had a fantastic North Sea database that reported monthly petroleum production on a well-by-well basis. This was stopped in December 1999, if I remember correctly. The replacement, a 'dumbed down' system at a holistic field level, doesn't increase understanding of the regional subsurface complexities, it fails to educate investors about the particular risks, and it doesn't help promote research. Government, industry and academia all need to up their game to ensure the North Sea survives (initially), after which we will be in a position to go forward.

I would encourage all countries, and especially the UK, to promote collaboration, access to data, and the sharing of knowledge and expertise. When everything is made open and accessible, you will always find experts, volunteers, practitioners, willing to propose ideas, possibly for free, you never know. If the oil and gas sector remains closed, untrusting, and overly competitive, then it becomes a race to the bottom of the barrel. I'm afraid that niche markets don't survive in situations like we are experiencing now.



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