

July-September 2021

# SPE Review London



The official e-magazine of the Society of Petroleum Engineers' London branch

## 50th birthday edition! Take a journey through time...

### Also in this issue:

- Using machine learning to generate accurate synthetic shear sonic log
- C-level talks: Gordon Birrell from bp
- London SPE Net Zero: Skills for the Energy Transition
- London SPE Net Zero: YP Career Transition in a Net Zero World
- SPE YP: The industry is growing and so are we!
- SPE London welcomes our 2021/2022 volunteers
- Net zero 101: UK ten-point plan summary
- Valuing everything: Six capitals stock model



LETTER FROM THE CHAIR

LETTER FROM THE EDITOR

# SPE Review London

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## ABOUT US

The Society of Petroleum Engineers (SPE) is a not-for-profit professional association whose members are engaged in energy resources, development and production. SPE is a non-profit professional society with more than 156,000 members in 154 countries, who participate in 203 sections and 383 student chapters. SPE's membership includes 72,000 student members. SPE is a key resource for technical knowledge related to the oil and gas exploration and production industry and provides services through its global events, publications, events, training courses and online resources at [www.spe.org](http://www.spe.org). SPE London section publishes SPE Review London, an online newsletter, 10 times a year, which is digitally sent to its 3000+ members. If you have read this issue and would like to join the SPE and receive your own copy of SPE Review London, as well as many other benefits – or you know a friend or colleague who would like to join – please visit [www.spe.org](http://www.spe.org) for an application form.

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## CONTACTS

Communications: [spelondon@spemail.org](mailto:spelondon@spemail.org)

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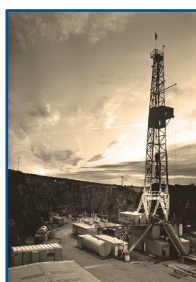
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## Behind the Scenes: SPE Review Editorial Board



### Elizaveta Poliakova, Editor in Chief

Elizaveta is a Reservoir Engineer at Trident Energy. She has an M.Sc in Petroleum Engineering from Imperial College London and a B.S. in Petroleum Engineering from the University of Leeds. Elizaveta has been with SPE for more than five years. She was the President of SPE Imperial College Chapter and the President of SPE Leeds Chapter. Previously, she was also on the committee of SPE YP.



### Josh Beinke

Graduated from University of Adelaide in 2008 with a Petroleum Engineering degree. After several years with Chevron moved to Europe in 2016, now working as an Exploitation Engineer with Vermilion Energy.



### Ffion Llwyd-Jones

Business editor and writer. Extensive experience in content writing and editing (digital and print). International experience in technology, health, and the environment.



### Mark Beleski

Experienced engineer, with deep understanding of industry practices, trends and challenges. Energy Loss Adjuster with AqualisBraemar, in London.

**A big Thank You! to all the organisations that support the SPE London section**





## Letter from the SPE London Chair



Dear SPE London members and colleagues,

It is an absolute privilege to be able to represent you as the Section Chair. I believe 2021/2022 session will be another crucial year for SPE as we face the challenges and tap the opportunities of the Energy Transition and the pandemic. For me and the team of volunteers that support SPE London Section activities, the focus is to deliver the value to you as our members and the greater community that depends on the technical expertise and potential of our Society.

I believe that in this upcoming year it will be crucial to balance how we return to our activities, and I hope that in my role I can support the section to maximise the benefit we can offer.

The pandemic has moved our activities online. This has enabled us to tap global expertise for our Technical Programme, chaired by Tim Lines, and make the attendance more accessible for our members. However, much is lost from lack of human connection and ability to build the network and relationships, member-to-member, in person. We will explore a new way of setting up our activities so we can continue to enjoy the benefits of both worlds.

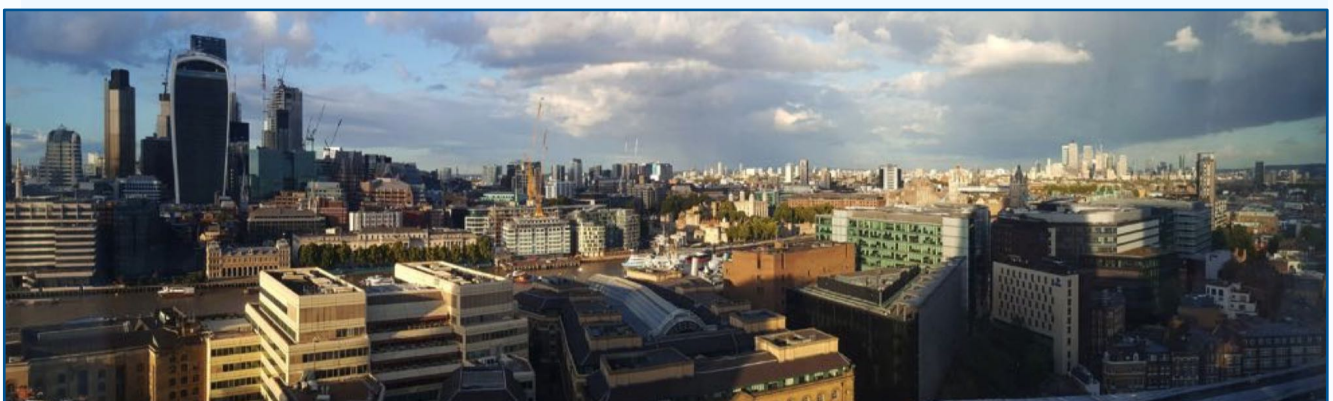
Energy transition and sustainability continues to be the focus of our industry and of interest to our members. The Net Zero Committee activities, chaired by Alison Isherwood and recognised on European level by the Regional SPE Award, have been the success story of last year and will continue this year. SPE core expertise will be the foundation of energy security that underpins the transition, and we will ensure that we allow opportunities for members to build and share the skills needed for the future.

Another benefit of this year is a greater collaboration with SPE on global and regional levels enabled by the virtual working. I feel especially energised and excited about the opportunities ahead for our members on this front having returned from the Regional Section Officer Meeting in Budapest. Our members can take advantage of such activities as the **SPE Europe Energy GeoHackathon**, that would enable an opportunity not only to gain Data Science Skills but also to apply them using real data, and **SPE Beyond the Borders**, which provides a chance to build lasting connections and the exchange of technical knowledge between SPE Sections. I hope we can continue to build this global relationship while restoring local activities post Covid.

We are here in the service of our members! I look forward to getting to know all of you better as the Chair of SPE London both online and, hopefully, in person. Please feel free to get in touch with any opportunities you can see for us to add value to you as members and if you would like to volunteer with us, we would welcome any helping hand to make our Section stronger.

Kind Regards,

**Adam Zalewski, SPE London Section Chair**





# Letter from the Editor



Dear SPE members and colleagues,

Happy SPE New Year and welcome to our fourth edition of SPE London review in 2021. We hope you all had a great summer! This publication marks the 50th anniversary of our chapter and we would like to invite you to look at all the beautiful memories, short stories, and photos from our member's careers between 1971 and 2021.

The new SPE year also greets us with the new Board. Please join me in welcoming our new Chair, Adam Zalewski, and his team that you can see on **page 44**. On this note, I would also like to thank Adrian Southworth, our past Chair, for all his great work and efforts during this uneasy year. The SPE London team is growing and over the past few months we have welcomed six volunteers: Cyril Pepple, social media content volunteer lead; Jennifer Adepoju, website volunteer sub-lead; Shalom Amakhabi, editorial volunteer sub-lead; Kamil Kakar, media volunteer sub-lead; Umair Tariq, membership communications volunteer sub-lead; and Nabila Suleiman Muhammed, content volunteer sub-lead 2. Please refer to **page 20** for their bios.

In this publication, Gordon Birrell, bp's Vice President for Productions and Operations, shared his career story with us in our latest C-Level talk (**page 7**). SPE London Net Zero published two articles following the two summer events: 'Skills for Energy Transition' and 'YP Career Transition in a Net Zero World'. The articles can be found on **page 09** and **page 11** respectively. On **page 15**, you can find a very interesting read from Ilia Chaikine on 'Using machine learning to generate accurate synthetic shear sonic logs'. In this publication, the Net Zero 101 series reviews the UK's ten-point plan on **page 22**. Please refer to **page 29** for our sixth article from the SPE London Net Zero committee, by Adrian Gregory, on 'Valuing everything: six capitals stock model'.

Lastly, I would like to thank our Editorial Team for all the care, efforts, insights, and momentum!

Stay safe and take care,  
**Elizaveta Poliakova**

[Click here to access past issues of the SPE Review London!](#)



# NEWS DIGEST... NEWS DIGEST... NEWS DIGEST



## **Baker Hughes and LYTT collaborate to hasten digital transformation in oil & gas**

LYTT and Baker Hughes announced their collaboration to accelerate digital transformation in Oil & Gas. The agreement will allow customers to apply distributed sensor networks in wellbores, aimed at optimising production.

Further movement to digital also enables remotely supervised operations leading to a potential reduction of HSE risks. Digital applications are also expected to be transferrable to customers in steam-assisted gravity drainage, carbon capture, utilization, and storage, and geothermal.

[Read more](#)

## **Net-zero standard for Oil & Gas has been set by investors**

Institutional Investors Group on Climate Change (IIGCC), the Transition Pathway Initiative (TPI), and over 20 global investors joined oil&gas majors to align net-zero expectations for the industry. Investors have highlighted that the companies now need to demonstrate clear and credible plans to achieve net-

zero. The partnership characterised several alternatives that can help the companies with the task:

- 1: Expanding into renewable energy;
- 2: Helping customers with low carbon energy transition;
- 3: Reducing emissions and innovation the area;
- 4: Ceasing exploration.

[Read more](#)

[Read the full report by IIGCC here](#)

## **OGUK urges to sustain North Sea gas**

Maintaining investments in the UK's North Sea gas production has been highlighted by surging gas prices. According to OGUK, declining supplies from Russia, lower European gas stocks, and a strong LNG demand from Asia have driven gas prices by 70%. This led to two large fertiliser plants closing due to high prices in the UK and to rising prognosis for house energy bills across the country during colder seasons.

There is an ongoing debate on whether sanctioning the new oil and gas field developments should take place.

[Read more](#)

## **Oil & gas worth estimated at £18 billion to north-east**

According to OGUK, the industry provides 71,500 jobs across Scotland representing a third of all oil and gas jobs in the United Kingdom. This is forecasted to create ~12% of the total Scottish GDP. Jenny Stanning, OGUK's External Affairs Director, said: "This latest report highlights the enormous role that the oil and gas industry plays in Scotland's economy, and especially in Aberdeen and Aberdeenshire". The industry is expected to play a key role to help the UK and Scottish government achieve their net-zero ambitions.

[Read more](#)

[And here](#)

## **Abu Dhabi's Taqa to sell UK and Dutch O&G Assets**

According to Bloomberg, the national petroleum company of Abu Dhabi, known as Taqa, is considering selling its oil and gas assets in the United Kingdom and the Netherlands. The company is currently reviewing its onshore and offshore production and exploration operations.

[Read more](#)

[And here](#)

# Fresh opportunities: Digital, agile, and diverse



**Gordon Birrell is bp's Vice President - Production & Operations, based in London, UK. His previous roles at bp include Head of Upstream; Chief Operating Officer, Production, Transformation and Carbon; bp Regional President Azerbaijan Georgia Turkey; Head of Safety and Operational Risk (Global Production Division); Head of Special Project; Head of Safety and Operational Risk (Global Production Division); and Head of Safety and Operational Risk in bp's global production division.**

## Who is Gordon Birrell? Tell us about yourself.

I grew up in central Scotland and my dad was a farmer. I went to a council-run school and then to Heriot-Watt University in Edinburgh, where I studied Electrical & Electronic Engineering. My father's farm overlooked an oil rig construction yard, and from a young age, I saw rigs being built. This made me want to work in the oil industry. I have two grown-up sons and my hobbies are golf, skiing, running, travel, and some farming.

## How did you become an Executive Vice President at bp? Talk us through your career.

When I left university, I worked for Schlumberger for a while and then I joined bp. I was still early in my career and managed to join bp's graduate training scheme, as a part of which I worked in the North Sea and Shetlands. For about 10 years I did various roles – mostly technical, a little bit of commercial, but mostly technical roles in the North Sea. After that, I worked in the London corporate centre for a time, and then I went to Azerbaijan for the first time. This was in 1999, when we were thinking about developing the giant Azeri-Chirag-Gunashli (ACG) field and were appraising one of its reservoirs. I worked there for a couple of years and then went to Alaska, where I was running some of our fields. Then I went to Canada and was responsible for the gas business that we eventually sold. After returning to the North Sea, I became a VP for technical activities based in Houston. This was when the Deepwater horizon incident happened, so I joined the response team – I was part of the team responsible for capping the Macondo well. After that I did a safety role based in Houston and then returned to Baku to become the Regional President for Azerbaijan, Georgia, and Turkey in 2012. I was in that role for

nearly five years. At that point, I was asked to join the Upstream Executive Team in the role of Chief Operating Officer for Production, Transformation and Carbon. When Bernard Looney became CEO in February last year, he asked me to become the EVP for production & operations, responsible for bp's hydrocarbons operations. So, it's been quite a journey.

## Prior to moving to the UK, you were based in Azerbaijan. How different were your experiences of leading teams in other countries and cultures?

I would say it was eye-opening. When I first went to Baku, I was probably overconfident in my abilities to run oil & gas assets. Upon my travel there, I saw how small local companies were capable of running oil & gas fields on very low budgets. This was a big eye-opener for me that you could do things very differently. I also learnt a lot about being more sensitive to people depending on their background and culture. While I was in Baku in 1999, I met Heydar Aliyev, who was, at that time, the President of Azerbaijan. I then got to meet his successor, Iham Aliyev. I also got to meet the Prime Ministers of Georgia and Turkey – it was a very exciting time. One of my proudest achievements is in helping to develop the Southern Gas Corridor to take gas from the Caspian Sea to Europe for the first time. This involved a series of mega-projects, over many years, with pipelines built from offshore to the Sangachal terminal in Baku, then through Azerbaijan, Georgia, Greece, and Albania, under the Adriatic Sea into Italy where it connects with the European gas market. It was a huge undertaking and a big milestone for Azerbaijan in particular.





## Fresh opportunities: Digital, agile, and diverse... continued

### **You studied Electrical and Electronic Engineering for your bachelor's degree. How was your transition to the oil and gas sector?**

I went into instrument engineering, which is very electronically based. There was a natural transition from instrument engineering to electrical engineering and then to oil and gas. As I mentioned before, I worked for Schlumberger, so I got to learn a lot about wells and subsurface and other engineering disciplines during my training. Overall, I found it to be a very smooth transition.

### **Do you believe your MBA changed your career in any way? When and why do you think oil and gas professionals should pursue it?**

I believe the MBA did change my career and it was right for me because my technical education was deep, but not broad. For example, mathematics, physics, chemistry, engineering theory were all subjects taught to me in great depth. That said, doing simple project economics was not something I was taught and that is where the MBA helped me massively. Especially for skills such as reading balance sheets or writing an investment proposal. In fact, I still use some of the things I learnt during my MBA, such as change management and information management. For me, the MBA was very liberating and broadened me enormously. I am not sure if it is right for everyone, but certainly for me it was very helpful.

### **Where do you believe the oil and gas industry will be in 10 years and what advice can you give to young professionals who just joined the industry?**

In 10 years, I believe, there will still be very healthy exploration and production businesses. There will certainly be a broader mix of energy, but the world will still need oil and gas for many decades to come. It will most certainly look different, and, I hope, it will be much more digital and agile. I also hope that the industry becomes more diverse and richer in cultures, genders, and nationalities. Moreover, I think we will have people capable of working not only in oil and gas, but also in other types of energy. Big companies such as bp are aiming to become

integrated energy companies. We are still very much an oil and gas company, but we also produce renewable energy and low-carbon products.

Professionals of the future need to be able to move between different types of energy. I think we are already well-positioned for that – if you take reservoir engineers, for example, they are usually very numerate, very strategic, they understand physics, and I think people like that can easily transfer to other types of energy. At bp, my view is that you can have a long and enjoyable career in oil and gas if that's what you want to do, and also have options to work in different energy types, applying your skills and experience and learning new things along the way.

Our operations also need to become more sustainable in terms of how we manage emissions, water, air, discharges, the materials we use. In my experience, our employees are embracing the challenge to keep improving how we safely produce oil and gas in a lower carbon, more sustainable way.

### **Have you observed change in the challenges that are specific to operations over the last decade? If so, what key themes have you seen emerge?**

The demands of society are now much higher on the sustainability side. Society and governments demand that we take care of emissions, air quality, water that we are using, and that we take care not only of our employees, but also of local populations in the countries we operate. The expectations are much higher now compared to before, including the expectations of transparency on how our production sharing agreements or tax and loyalty agreements are structured – making sure that the flow of funds is fully transparent. These expectations have increased dramatically in the last 10 years, and rightly so – it's a huge improvement for the industry.

The use of digital tools in our industry has also changed immensely and will continue to develop at pace.

**This has opened fresh opportunities in finding new types of oil and gas or discovering new reservoirs around the world and developing them much more efficiently than we have in the past.**

# SPE London Net Zero committee: Skills for the Energy Transition

The London Net Zero committee, in association with the SPE International Gaia Sustainability programme, kicked off its virtual programme in May 2021. The programme of events is centred on three themes: Alternative Perspectives, Managing the Budget, and The Human Aspect, as outlined in the table below. Alison Isherwood provides this overview.

June saw two panel discussions focused on the Human Aspect of getting to net zero, 'Skills for the Energy Transition' on 10 June and 'YP Career Transition in a Net Zero World' (see the following article) on 22 June. Both sessions explored how oil and gas workers can play their role in the future of energy, probably one of the most important question from our SPE membership.

London SPE Net Zero Gaia Committee: The Bigger Picture		
Theme	Questions	Gaia Framework
Alternative perspectives	How do those outside petroleum engineering, and outside O&G view our required journey to net zero? What innovation/change is needed? How will policy drive this? How are other industry sectors mapping their paths to net zero & what can we learn from them? How does the rest of the energy sector work?	Listening, collaborating, innovation, energy transition
Managing the budget	How do we manage both the financial and carbon budgets to get to net zero? What is the scale of action required in different areas? What business models and financial frameworks are needed? What part does offsetting and carbon pricing/taxes play? What is the right portfolio of action to balance social, environmental and economic goals? How do we measure emissions and impact consistently to drive action?	Measuring what matters, innovation, energy transition
The Human Aspect	How should O&G workers be preparing for the future of energy? How do subsurface specialists in particular need to upskill, what options are available to do this? What energy transition career/upskilling journeys have others been on that we could learn from? How do we continue to attract students into the energy industry? How do we create the culture of an integrated energy industry? How do we manage change? How do we win hearts and minds in the O&G industry to pursue net zero ambitions? What is the human impact of alternative pathways forward?	Social responsibility, listening, communicating, engaging and collaborating

The 10 June event panel featured industry and academic leaders discussing skills:

			
<b>Alix Thom</b> Skills and Employment Manager, OGUK	<b>Martin Blunt</b> Professor & Chair of Petroleum Engineering, Imperial College London	<b>Carl Hickson</b> Head of Talent Projects & Education, bp	<b>Jonathan Redfern</b> Professor & Chair of Petroleum Geoscience, University of Manchester & Energy Transition CMT
			

Overall, the message from the panellists was that there is huge transferability of core technical and operational skill sets from oil and gas to the wider energy industry but that the context in how these skills will be applied is changing.



## London SPE Net Zero committee: Skills for the energy transition... continued

Alix said there was a moral imperative to leave no one behind in terms of the workforce and their communities, which has been recognised by the UK government through the Green Jobs Taskforce Report, but that the business imperative should support this because the transition cannot happen without core oil and gas skill sets. However, there was also wide acknowledgement from the panel of the considerable uncertainty at the moment, in terms of exactly what skill sets will be in demand in the future and when. Alix was hopeful that the roadmap to net zero should become clearer over the next year, with a likelihood of some early employment peaks associated with capital expenditure before we move into a low carbon steady-state out in the future. Alix also pointed out there are positive signs that O&G companies, including consultancies and service companies, are already moving to be broader energy companies.

This led to a discussion about adaptive skill sets being absolutely key for workers to navigate the energy transition with Alix citing “resilience, curiosity and comfort with change” as most important. Martin highlighted the importance of computational skills and discussed how Imperial are adapting their courses to incorporate data science and machine learning as well as more general project skills.

Both Jonathan and Martin highlighted what a challenging time it is for University Petroleum departments at the moment with a stark reduction in graduate study over the last 5 years, especially in terms of UK students, to the point where several courses are being suspended. While departments are working hard to redesign their courses for a wider energy future, they are doing so in a very fluid, uncertain market, with a clearer roadmap needed to ensure teaching aligns with future job prospects for students.

Alix highlighted that oil and gas will remain a critical part of the energy mix for years to come and we should be continuing domestic production rather than offshoring emissions. Carl confirmed that bp is not turning its back on O&G, it is a core part of its forward strategy but there will be bold shifts in their portfolio over the next decade. Jonathan highlighted a need to continue to train some O&G specialists going forward and how we need to try and find the right balance between training generalists who can work across many sectors and such specialists. Jonathan pointed out the leading global position the UK currently holds in teaching petroleum geoscience and engineering and how it is important this is not lost in a rush to transition.

The need for better communication was highlighted throughout the panel discussion, in particular, the importance of widening this conversation beyond those already working in our industry to school children, their parents, teachers and the general public in order to secure the talent pipeline we need going forward. While it was acknowledged that the oil and gas industry has an image problem, it was agreed we should be able to do better at communicating the key role oil and gas still plays as well as painting a picture of an exciting future. It was highlighted that the challenge of creating an integrated net zero energy industry should energise young people to join it as somewhere they can really make a difference. This was something the London Net Zero committee experienced first-hand when they ran the February 2021 [Arkwright Careers Day](#) with a group of talented young students.

Jonathan highlighted the work the Energy Transition CMT is doing to get flexible learning resources to students and working professionals wanting to upskill. He highlighted the collaboration that is starting to build between learning institutions to consolidate dispersed expertise in emerging energy areas. He was confident that learning resources will just get better and better through this initiative for motivated individuals wanting to learn. Carl highlighted the wider culture of learning that needed to be cultivated in the industry during this period of transition, layering formal education with informal learning using mentors, peer learning, on the job and special assignment opportunities.

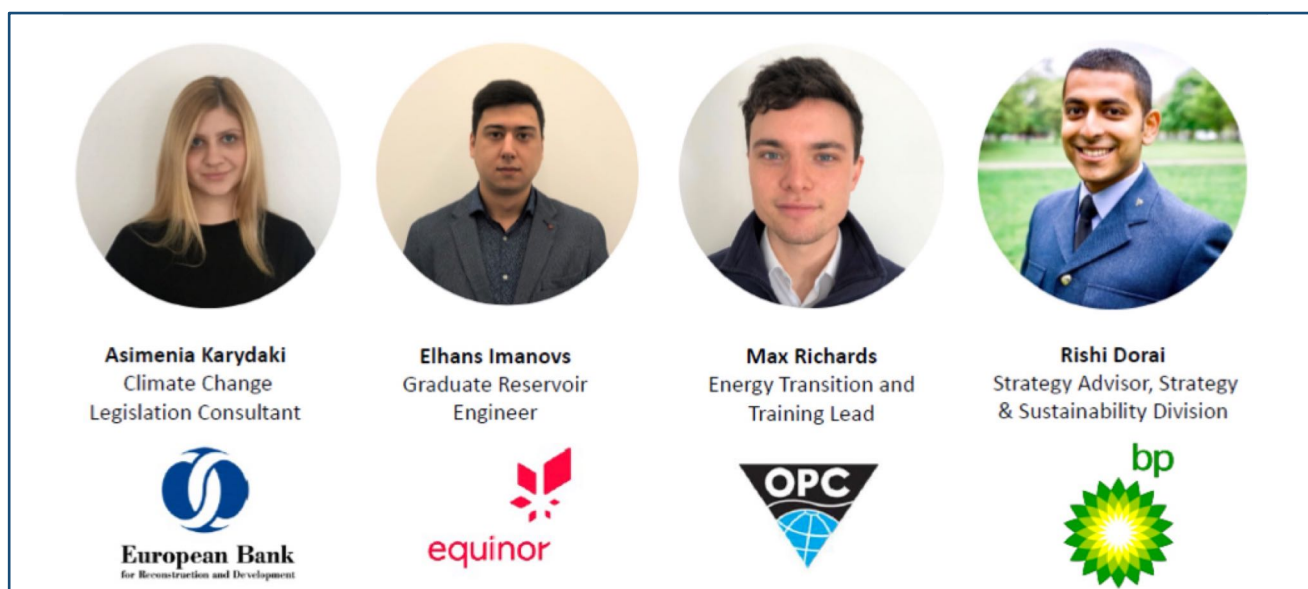
**The need for individuals to take control of their own development and seek out opportunities to learn is a theme that carried forward very strongly into our 'YP Career Transition in a Net Zero World' panel session on 22 June (see report on the following pages).**



# London SPE Net Zero committee: YP Career Transition in a Net Zero World

The 22 June event was focused on learning from others' personal career stories with lots of useful advice shared. Davis Bigestans provided this report.

The event featured a diverse set of YPs:



Generally, young professionals are enthusiastic about the start of their careers, but can 'Resilience, curiosity and comfort with change' be a defining facet of them? The phrase coined by OGUK manager Alix Thom during the 'Skills for Energy Transition' panel proved to be a catalyst for conversation for four young professionals discussing their career transition in an evolving net zero world. In an open, passionate and witty discussion the multidisciplinary panel shared their career journey and gave advice to industry peers that reverberated with the theme of resilience, curiosity and comfort with change.

Right at the very beginning of the panel, **Rishi Dorai** set the tone for what turned out to be a great comfort with change. Being a proven petroleum geologist at bp, Rishi felt a desire to craft himself even more – beyond the level of his comfort zone. A successful project on bp's global carbon emissions (Scope I to III) proved to be a pivotal and career-defining moment back in 2017. And the rest just followed. Rishi moved on from his E&P role to join the multidisciplinary Sustainability team, shaped by the incoming executive Bernard Looney who tasked them to "get to the heart of Net Zero". Looking back, Rishi acknowledges that his passion to craft himself was a catalyst in his journey so far and believes that anyone who pushes hard enough can create the opportunity for himself/herself. A careful reader might have noticed that the last sentence illuminated Rishi's traits of leadership. Not surprisingly, one of Rishi's main extracurricular activities are devoted to One Young World where he along with other young leaders drive solutions to some of the most pressing issues in the world. Collaborating, inspiring others around and using One Young World as an amplifier for change are further attributes of Rishi that resonate with his core message to the panel discussion: "You can shape your career journey; (..) no matter whether the opportunity is in front of you or you have to work for it." Rishi also highlighted that individuals should be proud of their technical foundations and experience in oil and gas which he described as the "engine room" of the energy transition and how you can still make a significant impact while working in oil and gas, especially as this will be a long transition, it is not a 'binary switch'.

If for one panellist it was the comfort with change then for another it was the curiosity that led to a U-turn career moment. **Asimenia Karydaki** started her journey as a BSc student majoring in geology and geo-environment but soon found herself as an aspiring law/energy professional. Completing a legislative/environmental focused bachelor's thesis and receiving a Graduate Diploma in Law from an UK university



## London SPE Net Zero committee: YP Career Transition in a Net Zero World... continued

presented her with an opportunity to embark on a UN Climate Change Toolkit project. Similar to Rishi, being curious and inquisitive about new opportunities helped Asimenia to become a part of the changing landscape in the energy industry and start her career as an energy legal analyst at Barrows Company. During her stint with Barrows, Asimenia recalls that she was amazed to see the considerable push for renewables made in Africa and Asia when providing investment analysis for green energy at Barrows. Now working as a Climate change legislation consultant at the European Bank for Reconstruction and Development, Asimenia encourages the young professionals to recognise the business opportunity that energy transition has brought forward and be ready to capitalise on it. And, for her, extracurriculars were as important as to Rishi. Whether leading a Renewable Energy model drafting project or forming a part of the Sustainability and Just Transition Energy Society committee at the University of Dundee Asimenia conveyed a clear message about the breadth and depth of opportunities that extracurriculars can bring on. “Be adaptable, flexible and open-minded”: that is Asimenia’s genuine and encouraging advice to any industry peer.

But energy transition for some is more than curiosity and comfort with change – it is resilience on a full spectrum. **Elhans Imanovs**, a graduate reservoir engineer at Equinor, proved that one’s interest in petroleum engineering and low carbon future is vital for a feasible transition but requires a resilient and agile mindset. For Elhans, discovering his passion for carbon sequestration during projects at the University of Manchester and Imperial College London helped him to shape a robust skills portfolio that he now applies to work on low carbon vision at Equinor. One could feel that the scope of projects that Equinor has embraced is creating value and opportunities even outside the boundaries of the company. This resonated with the idea of a business opportunity that currently exists, and as Rishi put it, anyone who pushes hard enough can get involved and pivot their careers. Elhans also highlighted the impact you can have while still working in oil and gas, especially if you are open to getting involved in projects outside of your core discipline. He highlighted a personal example of looking at the CO2 emissions of an offshore platform at the same time as doing the reservoir engineering work for the asset.

Yet behind the theme of 'Resilience, curiosity and comfort with change' a key idea was lurking that the final panellist **Max Richards** elegantly unpacked. Networking has always been thought as one of the main foundational pillars for a successful career start which applied to Max in a fashion hardly one could think of. What started as a regular evening shift at a local bar in London for Max turned into a dramatic networking opportunity with an oil & gas consultant. If before it, Max was unsure what to pursue next after his graduation in 2020, then with a valuable networking advice he turned his attention to carbon capture and storage and embarked on a related thesis project thereafter. But that’s hardly the best part of his networking experience. Max managed to persuade his now current boss at OPC (oil & gas consulting company) to hire him as an Energy Transition and Training Lead where he is currently helping to shape the future of a clean energy transition. Max got down to the roots of networking when stating that you might have “no idea who are you talking to and where can it lead”. Blunt, yet an honest comment. Likewise, Max was keen to point out that his journey into a net-zero related job ticked just a one out of so many boxes available. As he said, “there are many other ways how you can gain foot in the door other than [with a] graduate scheme”. As a final note, Max’s sheer interest in explaining the way how world functions and a desire to make a positive and tangible impact on key issues such as climate change and sustainability might have made an unconscious effect when persuading his current boss for a job offer.

**What first started as a wise comment by Alix Thom on adaptive skillset in the previous panel was turned into a full-fledged conversation by four young and aspiring professionals. Resilience, curiosity and comfort with change will be some of key pillars when contemplating and acting upon career transition. For young professionals, interest in making the world a better place might serve as a catalyst for change. For the experienced, the passion from young professionals can be a great starting point for change.**

**Even if the opportunity does not exist at first, a pragmatic or ambitious initiative can spark change and help unite a competent and skilful energy industry for the better of the environment, society, and business.**

## The energy industry is growing, and so are we!

I am proud to introduce our new committee members for the academic year 2021 – 2022. With the current ease in COVID-19 restrictions, we are hoping to hold many of our events in-house.



Shwan Dizayee  
YP Chair

As an SPE YP committee, we strive to bridge the gap between industry thought leaders and graduates/young professionals through knowledge sharing initiatives and workshops.

"I am excited by the dynamism and range of backgrounds within our committee this year and I am confident that the year ahead will be another great year for the section, and a vital one as our future leaders navigate their way through the industry."

"We have some truly insightful initiatives coming up that cannot be missed!"

The start of the year is looking very exciting with the **SPE YP London Women in STEM – Leadership event** on the 21 October. We are hosting a panel discussion with Sharon Howe from CGG, Clara Altobelli from Serica Energy, Eleanor Rowley from Cairn Energy and Patricia Vega from Quantum New Energy, moderated by Zahraa Alkalby who is the SPE D&I chair and a reservoir engineer at Total Energies. In this event we are hoping to help the industry's current efforts to promote the women's role and leadership and emphasize the importance of a diverse environment for a successful business.

**Peter Milhalik from bp** will join us in December as a speaker for our well modelling event and we are definitely looking forward to the **Expro Group Lab visit** in February 2022 at the Expro fluid analysis centre in Reading. We are also happy that our **annual IHS Market event** with Layla Mahmood might take place at the IHS Market office in London in May next year.

The '**Meet the young professionals**' series is continuing next year with our key speaker Yasir Thara from Wintershall DEA, and we are planning to hold the event at Imperial College London if the campus is officially opening doors for students in January.

On behalf of the SPE YP Committee, we wish you all a happy and healthy new academic year. We are looking forward to hearing good feedback from the audience and their suggestions for future events.

### Meet our new members:



Arsenij Fiodorov  
YP Net Zero / CCS Lead



Muhammad Abbas Hamid  
YP Student Development /  
Technical Lead



Hajara Kabir  
YP Diversity / Inclusion Lead





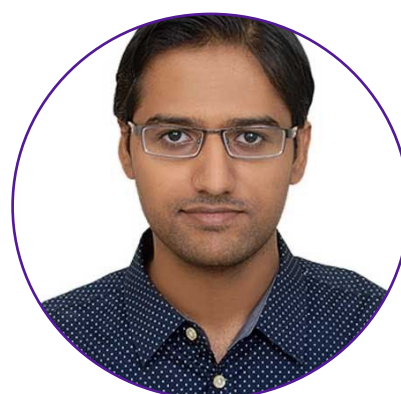
## The energy industry is growing, and so are we!... continued



**Sagar Kalra**  
YP Industry Collaboration /  
Partnerships Lead



**Kareem Sharif**  
YP Policy / Regulation Lead



**Osman Khan**  
YP Digital Transformation /  
Data Analytics lead

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And here are the people who formed the core of the YP Committee in 2020/2021, and continue to to be part of our growth:



**Samad Ali**  
YP Vice Chair



**Raghd Gadrboh**  
YP Events Coordinator



**Muhammad Usman**  
YP Technical Lead



**Natan Battisti**  
YP SPE Collaborations and  
Partnerships



**Vikas Kooneti**  
YP Social Media and Comms

# Using machine learning to generate accurate synthetic shear sonic logs



Ilia Chaikine works as a petroleum engineer at Sproule, which is a global energy consulting firm providing geoscience, engineering and operational expertise. His job involves evaluation of oil and gas assets, reservoir simulation and data analytics.

Ilia recently finished a PhD degree at the University of Calgary, which focused on applying machine learning algorithms to reservoir engineering forecasting and optimization problems.

## Abstract

Shear sonic travel time (DTS), along with compressional sonic travel time and bulk density are required in order to estimate rock mechanical properties which play an important role in fracture propagation and the success of hydraulic fracture treatments in horizontal wells. DTS logs are often missing from the log suite due to their costs and time to process. Here we present a machine learning procedure capable of generating highly accurate synthetic DTS curves. This is a condensed version of our study (Chaikine and Gates, 2020). This procedure is a cost effective and fast alternative to running DTS logs and with further development, has the potential to be used for predicting production performance from unconventional reservoirs.

## Introduction

Mechanical rock properties drive the way fractures propagate within reservoir rocks during hydraulic fracturing and the morphology of the fracture network dictates hydrocarbon production. The mechanical properties in an unconventional reservoir are anisotropic and heterogenous, which makes the production performance of horizontal wells highly dependent upon their location and orientation. Mechanical rock properties can be derived indirectly from a combination of three sets of log measurements, specifically: bulk density (RHOB), compressional slowness (DTP), and DTS. The DTS log is often missing due to its high cost and time to acquire. Empirical correlations which attempt to derive DTS from DTP were the main way to estimate DTS for many years, the difficulty is that although DTS is highly correlated to DTP, multiple other variables affect the DTS. Empirical correlations are also highly dependent upon the location and size of the study area, and result in poor estimates if taken outside that area. **Figure 1** plots DTS versus DTP data of the 14 wells used in this study, it is easy to see the highly nonlinear nature of the relationship.

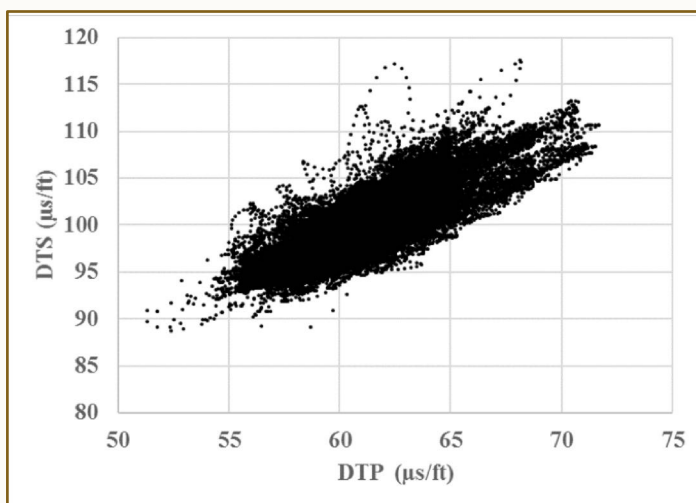


Figure 1: Plot of shear slowness (DTS) versus compressional slowness (DTP) measurements for 14 wells in the Montney Formation.

Since it is impossible to know all of the factors affecting the DTS, a better approach is to apply statistical methods. Machine learning algorithms have capabilities to integrate subtleties between data sets more than simple regression models. These algorithms work by learning patterns between input and output variables that are too complex for regular statistics to capture.

Artificial neural networks (ANN) are a set of algorithms inspired by neural networks found in the brains of animals where the networks map input variables to output targets and find correlations by observing many samples of the data. They are made up of several layers composed of nodes. Typically, every node in one layer is connected to every node in the next via a

weight factor, the network learns by updating these weights based on the data it sees. A network is said to be trained once it can achieve the highest accuracy on a validation set. Since there could be millions of weight



## Using machine learning... continued

values in a network, the only feasible way to update them is via backpropagation of a loss function initiated by an optimizer (Chollet, 2017). Recurrent neural networks (RNNs) are of particular interest as they are useful for sequence data such as logs since they retain a memory of previous patterns. Here we present a procedure that uses a hybrid variation of the RNN to generate synthetic DTS curves from DTP and RHOB logs and well deviation survey.

The Montney Formation in Canada is a tight siltstone/shale oil and gas play that spans over 500 km from southeast Alberta to northwest British Columbia and covers ~130,000 km<sup>2</sup>. The in-place resource volumes for the play are estimated at over 2,000 Tcf of gas and over 150 billion barrels of oil and condensate (Wang and Chen, 2016). The procedure is applied to a set of wells within a 30 km by 30 km study area in the Montney Formation. The area contains 145 vertical, 35 deviated, and 255 horizontal wells, an areal view of all the wells in the study is shown in **Figure 2**. A three-dimensional (3D) structural model of the study is shown in **Figure 3**.

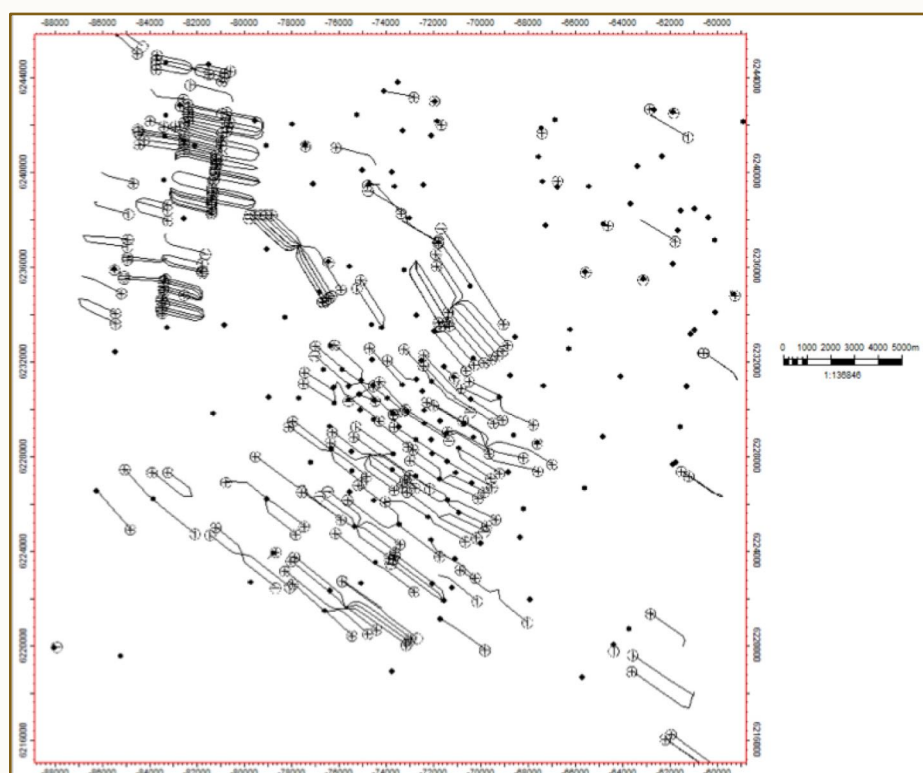


Figure 2: Aerial view of all wells used in the study.

Estimating rock mechanical properties requires three sets of logs: RHOB, DTP, and DTS. The majority of the wells have RHOB and DTS logs but only 14 have all three. **Figure 4** (on the next page) shows all the vertical and deviated wells without DTS marked by black points and the wells with DTS marked by a circle.

The following data was extracted for the wells: deviation survey, RHOB, DTP, and DTS logs. All logs were converted to a resolution of 4,000 steps per 100% reservoir thickness, which is 0.025% per step.

### Experimental Setup

The synthetic DTS curve was generated by using the following five inputs: x coordinate, y coordinate, true vertical depth (TVD) subsea, RHOB and DTP. Since there are only 14 wells in the data set, the only suitable method to determine accuracy is the “leave-one-out” cross-validation method. In this method, 13 wells are used as training data with one well to validate (blind), the experiment is then run a total of 14 times and the results of all 14 experiments are examined. The

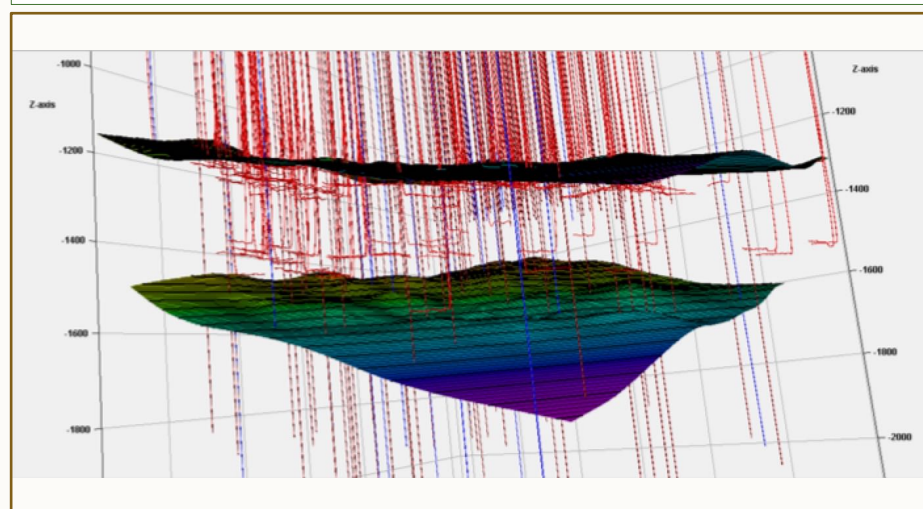


Figure 3: A 3D visualization of all wells in the study area. Red = horizontal, blue = deviated, and black = vertical.





## Using machine learning... continued

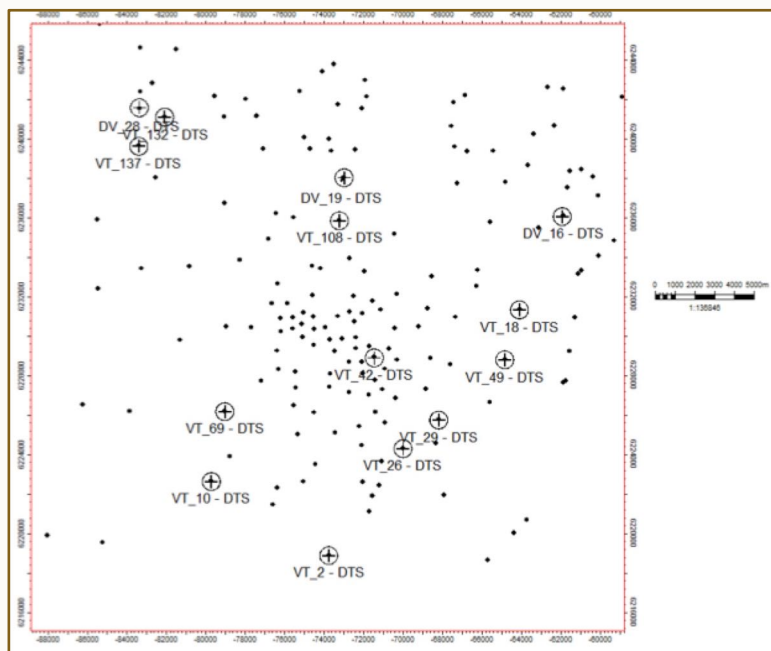


Figure 4: A real view of the study area generated in Petrel. Black points with no circles are wells with no DTS logs, circled wells have the DTS logs.

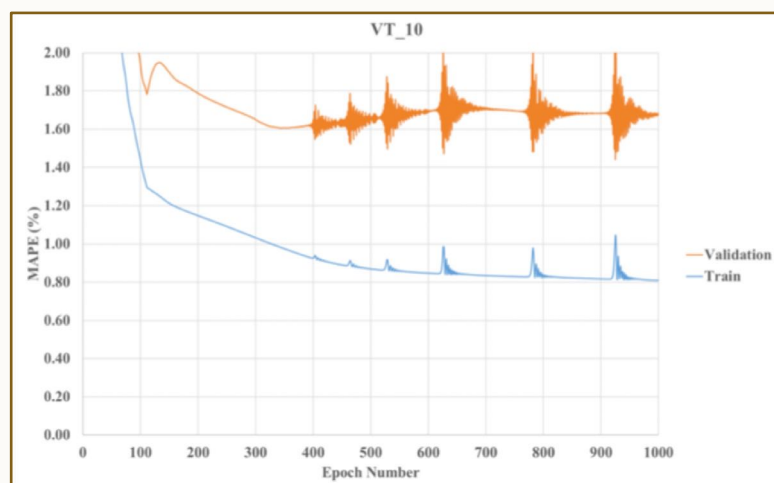


Figure 5: Training and validation error for one of the blind well tests.

network can be tuned after all 14 experiments are completed to see if an improvement is made. To insure consistency, the network in each of the 14 blind well experiments was reset and trained three times, without modifying any parameters or training procedures. The accuracy of the synthetic logs is compared visually and using the Mean Absolute Percentage Error (MAPE) metric.

A convolutional-recurrent hybrid (c-RNN) was chosen because it combines the speed and ability to process large amounts of data of a convolutional network with the sequence processing ability of a recurrent network. Deep neural networks are good at learning complicated relationships between inputs and outputs; however, if trained too long the networks start to confuse noise with signals and start to overfit to the training set which results in lower generalization capabilities (Srivatava et al. 2014).

To limit overfitting, we maximized the batch size and applied dropout. **Figure 5** shows how the training and validation error evolves over 1,000 training epochs for one of the blind well experiments. “Tremors” in both the training set and blind well error start to occur at fairly regular intervals after ~400 epochs and the error rate seems to stabilize at a very low constant error between them. These tremors were found to be universal across all wells.

Since the validation error does not exist when generating synthetic DTS curves for wells with no DTS, only the training error can be used to determine when to stop the network. From Figure 5 it is seen that the tremors in both the training set and blind well occur nearly at the same time (validation tremor starts a bit earlier and ends a bit later than the training tremor). Since the training and validation tremors were found to coincide with one another, a simple empirical procedure was developed to determine the stopping criteria for the c-RNN:

- A: Run network for 1,000 epochs (when network has stopped improving results).
- B: If training error is stable and far enough away from the previous tremor, stop training.
- C: If training error is experiencing a tremor or very close to previous tremor, continue running network for 50-100 more epochs (but before next tremor occurs) until you reach a state in step B, stop training.
- D: If another tremor occurs, repeat C until you reach a state of B.

The procedure is not limited to the Montney and can be applied to any formation of interest.



## Using machine learning... continued

To test if the c-RNN has statistical significance, it will be compared to two baselines:

- 1: Taking the average DTS/DTP ratio of training wells and applying it to the blind well
- 2: Taking the average DTS minus DTP value of training wells and applying it to the blind well.

The network will also be compared to the DTS estimates of two popular empirical correlations:

- 1: Castagna et al. (1985) for shales:  $V_s(\text{km/s}) = 0.77 V_p - 0.8674$
- 2: Han et al. (1986) for shaly sandstones:  $V_s(\text{km/s}) = 0.85 V_p - 1.14$

### Results and Discussion

**Table 1** summarize the results of the leave-one-out experiments. The results show that the empirical correlations did not work well for this study. The likely reason for this is because the empirical correlations were developed from a very broad (global) set of reservoirs and do not translate great to specific (local)

well	Castagna et al.	Han et al.	DTS/DTP	DTS-DTP	Ave of 3 c-RNN Runs
VT_02	2.80%	2.19%	1.24%	1.03%	1.00%
VT_10	2.31%	3.17%	1.61%	1.53%	1.76%
VT_18	1.79%	3.47%	1.35%	0.93%	0.66%
VT_26	3.39%	2.55%	1.80%	2.29%	1.02%
VT_29	3.80%	1.89%	1.87%	2.15%	1.27%
VT_42	7.05%	3.27%	4.07%	3.11%	1.02%
VT_49	1.53%	3.95%	1.66%	1.01%	1.40%
VT_69	6.41%	2.84%	3.29%	2.11%	1.20%
VT_108	2.05%	3.01%	1.43%	1.31%	0.99%
VT_132	2.73%	2.73%	1.36%	1.37%	0.95%
VT_137	4.59%	2.93%	2.17%	1.37%	1.99%
DV_16	1.60%	4.11%	2.17%	1.75%	1.01%
DV_19	2.57%	4.92%	2.95%	2.32%	1.27%
DV_28	2.67%	3.12%	1.78%	2.15%	1.52%
<b>Average</b>	<b>3.21%</b>	<b>3.14%</b>	<b>2.03%</b>	<b>1.73%</b>	<b>1.22%</b>

Table 1: Results of the study comparing the performance (MAPE) of the various methods of generating synthetic DTS curves.

reservoirs wells. The simple baselines performed about twice as well as the empirical formulas, this is no surprise as they were derived from the average of 13 training wells, making them very local and only applicable to this particular study area. The c-RNN shows statistical significance as it outperformed the simple baselines and the empirical correlations.

Wells VT\_10 and VT\_137 had the highest error rate in the c-RNN runs. As shown in Figure 4, these wells are located near the edge of the study area where not many wells have been drilled, so their accuracy is not of great importance for the purpose of this study. Most of the vertical and horizontal wells are drilled near the center of the study area closest to well VT\_42 and four other nearby wells: VT\_26, VT\_29, VT\_69 and VT\_108.

It is important to focus on these wells as they dictate the success of the network to generate synthetic curves for the majority of wells with no DTS.

From the results, VT\_42 had a MAPE of only 1%, the other four wells also performed fairly well with an MAPE close to 1%. **Figure 6** shows the synthetic curves generated by the c-RNN compared to the true DTS curves for the centrally located wells VT\_26, VT\_29, VT\_69 and VT\_108.

### Conclusions

A procedure to generate highly accurate synthetic DTS curves has been developed. This procedure can act as a cost-effective

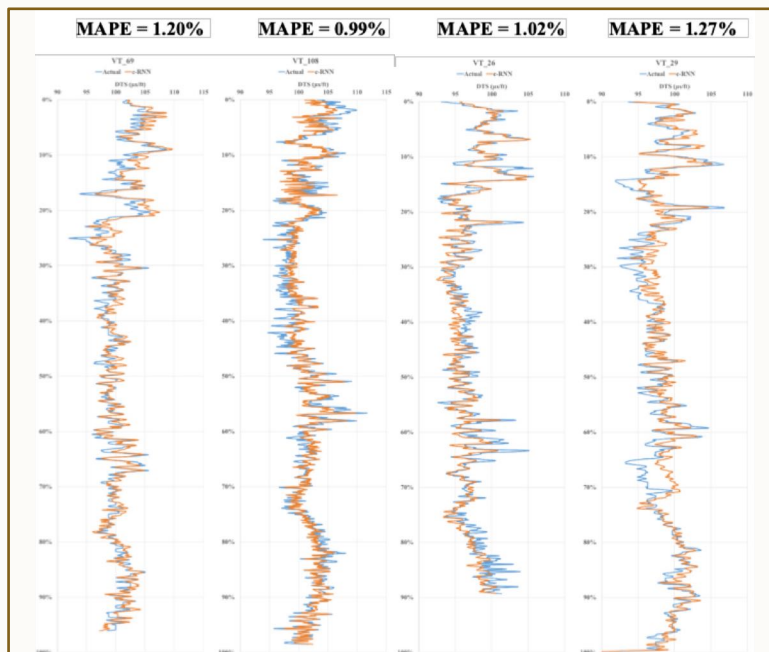


Figure 6: Synthetic logs generated by the c-RNN for four wells compared to the true logs.

## Using machine learning... continued

and fast alternative to running actual DTS logs. This does come with the condition that the area of interest is small enough and that there are enough wells with true DTS measurements available. Generation of a synthetic DTS measurement at a given point along the reservoir thickness only required five inputs: x and y coordinates, vertical depth subsea, RHOB and DTP. The procedure does still have room for improvement.

Some potential reasons for the error in the synthetic DTS curves are:

- 13 training wells are not enough to learn every possible signal.
- Some signals are caused by variables not captured in the study (ie. fractures, stress profiles, pore fluids, high porosity, shale, thin beds, gas presents, high total organic content (TOC)).
- DTS measurement error is caused by the tool itself or poor borehole conditions.

Although the network did perform poorly on two of the blind well tests (VT\_137 and VT\_10) it is more important to look at the performance of wells located closer to the majority of vertical and horizontal wells. As there is no real way to measure synthetic DTS curve accuracy for wells with no DTS one can only rely on the results of the network for nearby wells. Most wells are located in the center of the study area and most of the horizontal wells reside in the top 25% thickness and the network has shown to be able to generate fairly accurate curves for that region of the study. The c-RNN has also shown to have fairly consistent results between the runs, but it is still suggested to take the average of three runs when generating synthetic curves for wells with no DTS.

This procedure is not limited to the Montney Formation, as long as the area is small enough and contains enough wells with DTS logs it could be applied to any other formation. Even in this small window of the Montney, the 250 existing horizontal wells only cover a small fraction of the thick reservoir and there is remaining opportunity for further development. Having a predictive procedure like this could potentially give the user a way to optimize where to drill and how to complete a horizontal well before it is actually drilled. If the number of wells per area is large enough the procedure could be applied to any other formation.

**NOTE: This is a condensed version of our study presented at the SPE Annual Technical Conference and Exhibition for more detail please read paper number SPE-201453-MS.**

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## SPE London welcomes our 2021/2022 volunteers



### ← Cyril Pepple: Social media content volunteer lead

Sponsored by Shell Nigeria, Cyril Pepple is a current MSc student in Petroleum Engineering at Imperial College London. He received his bachelor's degree with first-class honours in petroleum and gas engineering from the University of Port Harcourt, Nigeria. Cyril's interests cut across energy-efficient production processes, new energies, global leadership, and nation-building.

At SPE London, Cyril will collaborate with other team members in the Communications Team to create and disseminate content across the section's social media platforms.

### Jennifer Adepoju: Website volunteer sub-lead →

Jennifer holds an MSc in Petroleum Engineering from Imperial College London where she served as the Social Secretary for Imperial College SPE student chapter during the 2019/2020 session. She has been a member of SPE for the past seven years and has volunteered in multiple roles and in different student chapters. She is also a qualified Energy4Me trainer.

As the website volunteer sub-lead, Jennifer is working towards bringing effective change to the SPE London section website, to provide a meaningful and relevant experience to the user.



### ← Shalom Amakhabi: Editorial volunteer sub-lead

Shalom Amakhabi is an MSc Petroleum Engineering student at Imperial College London. She holds a Bachelors degree in Petroleum where she graduated in the top 1% in 2019. Shalom had an internship with Nigeria LNG where she worked as a technical intern with the Process Control unit.

She has been an SPE member for six years and held the position of the Nile University student chapter membership chairperson for two years, during which time the student chapter membership increased by 287.5% with a membership retention growth of over 68.5%. She is currently on the Fastfutures internship program, which is a 12-week course-based program that provides a detailed overview of a broad array of industries such as data analytics, marketing, finance,

and innovation. Furthermore, Shalom's MSc thesis was focused on the use of CCS with gas-to-wire for its integration with offshore wind energy, to provide an intermittent supply of energy with natural gas as a



## SPE London welcomes our 2021/2022 volunteers ... continued

bridge fuel to account for the sporadic availability of wind.

Her interests lie in energy, green financing and data management. As the editorial volunteer sub-lead under the communications team, she support SPE London Section's editorial activities.

### Kamil Kakar: Media volunteer sub-lead ➡

Kamil Kakar is a research enthusiast and holds an MSc degree in Petroleum Engineering from Imperial College London. He is an active member of SPE (since 2014) and has served the SPE student chapter BUITEMS as a vice president and General Secretary.

Kamil is passionate about sharing knowledge and is a freelance mentor on teacherOn platform. He recently volunteered for the Techpet Global Services Nigeria as a Petrotechnical analyst and SPE London section communication team as the media sub-lead.



### ← Umair Tariq: Membership communications volunteer sub-lead

Umair is the Development Support Lead at KAPPA Engineering, focusing on PTA, RTA, numerical modelling and PVT applications and workflows. He previously worked for Schlumberger as a Field Engineer in Well Testing Services, in the Middle East and North Africa. Umair holds an M.Sc. in Petroleum Engineering from Imperial College and a B.Sc. in Mechanical Engineering from GIK Institute, Pakistan. He has been an active member of SPE since 2010 and has previously volunteered with the SPE London YP committee, organizing multiple industry events. He recently volunteered for the SPE London Section and will be supporting membership-communications activities.

### Nabila Suleiman Muhammed: Content Volunteer Sub-Lead 2 ➡

Nabila holds a B.Eng qualification in Petroleum & Gas Engineering from the University of Portsmouth and is currently completing an MSc in Engineering Project Management at Coventry University.

She has been a member of SPE since 2014 and joined the SPE London Section communications team as a Content volunteer. She intends to make a difference by engaging, learning and sharing knowledge that is needed for the energy sector to meet up with the global energy demands.



# Net zero 101: UK ten-point plan summary

Earlier in 2021 the UK Government set out 'The Ten Point Plan for a Green Industrial Revolution'. It is undoubtedly an ambitious plan for 'Building back better, supporting green jobs, and accelerating our path to net zero'. The plan aims to further enhance progress already being made on the UK's net zero 2050 goal and cushion the economic blow from Covid-19 by way of an 'industrial recovery'.

Harry Simons provides this summary.

Agreed in Paris in 2016 (COP 21) and passed into law in the UK last year, progress towards a target of 'limiting global warming to less than 1.5 degrees above pre-industrial levels', is a significant challenge. The Climate Change Committee (CCC), a statutory body set up to monitor and advise on the UK's progress to 2050, already has concerns about meeting our shorter-term goals, but while optimistic, highlights there is little room for clawing back lost ground if we miss targets along the way. The CCC advice so far can be seen in the principles for the 10 point plan from the Government. The CCC, politely urges the Government to 'get on with it'.

Industry responses to the plan have been positive. While highlighting concerns around areas of the plan such as infrastructure, financing, retraining and skills, industry clearly sees the opportunities in adapting to change. Critics have been keen to note a lack of detail with the plan, and offer scepticism around headlines such as 'Every UK home will be powered by offshore wind by 2030'. While this makes a (vaguely) good headline, as an announcement in itself, it does lack detail and is somewhat misleading. We should remember the UK operates a 'portfolio' of different power generation sources (wind, nuclear, gas, coal, solar PV, hydro and imports electricity from the continent when required) and will continue to do so, particularly with 'variable' generation, such as wind or solar PV; we need a fall back on grey, cold, windless days. It is notable that the plan doesn't mention Solar PV, yet this has a part to play in the UK's portfolio.

Point	Expected Investment	Possible Jobs	Possible CO2 savings (MtCO <sub>2</sub> e)	% Impact on 2018 figures / Other notes
Advancing Offshore wind	£20bn	60,000 in 2030	21 between 2023-2032	5%
Low Carbon Hydrogen	£4bn	8,000 – 100,000	41	9%
Advanced Nuclear Power	£300m	10,000 (during construction)	-	Power for 2 million homes
Zero Emissions Vehicles	£3bn by 2026	40,000	5 by 2032, 300 by 2050	Ban on new ICE* by 2030
Green Public Transport	£5bn	3,000 by 2025	2	Includes Walking and cycling
Jet Zero and Green Ships	Unclear, but projects aerospace sector worth £12bn	5,200	1 by 2032 by Maritime, 15 by 2050 by aerospace	Development of Sustainable Aviation Fuels (SAF)
Greener Buildings	£11bn	50,000	71	16%
Carbon Capture and Storage (CCUS)	£1bn	50,000 by 2030	40 between 2023 and 2032	9%
Protecting the Natural Environment	£5.2bn	20,000 (associated with flood defences)	unknown	Further jobs through land management and conservation
Green Finance and Innovation	£4.5bn	'Hundreds of Thousands'	unknown	unknown

The UK Government's plan is a 'framework' around which the recovery can be built, and as we must transition to a Net-Zero economy, the 'holistic' vision is well overdue. We now eagerly await the much-delayed 'Energy White paper' to set out policy and the basis for further consultation with industry, further strategy papers and delivery plans, which we should see as we move through 2021. These will begin to add some detail around policy.

Like any good plan, as we continue our net-zero journey industry will need to assess, review and execute on the plans, adjust as our progress develops, as detail needs to be adapted or optimised along the way. Like any good project, iterations of 'Review-Plan-Do-Adjust' are required (and should undoubtedly be expected).

We will talk about the various points in the plan in relation to the SPE membership and net-zero in the coming months. CCUS is of course a significant opportunity for our sector and we will discuss this in, in particular, in more detail in the future.

At this point, as a summary of the 10-point plan, the U.K. Government assesses the proposals will have the scale of impacts set out below. The figures noted (in the table, above) are initial government estimates, and as the 'framework document' (my choice of words) can be woolly at times (and hence the criticisms noted earlier), so it's probably better to look at the 'quantum' of the figures, rather than the absolute numbers themselves. And now imagine standing up in front of your management team and saying that ...

**In closing, by setting out this plan, the U.K. government presents a structure to which the necessary detail can be added. Better an imperfect plan now, than a perfect plan, if such a thing exists, too late...**



## SPE London section: It's our 50th!!

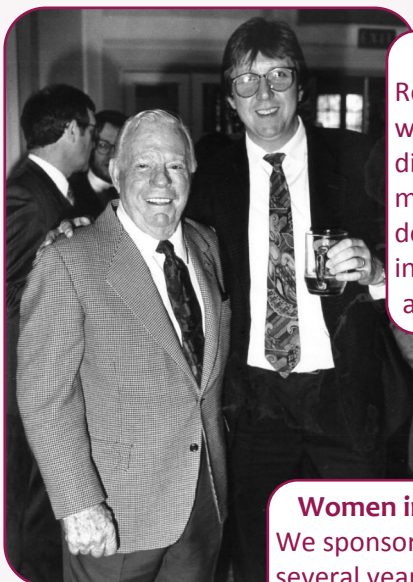




## It's our 50th anniversary!! continued

In the following pages, SPE London members share some significant events in their careers:

### Piers Johnson, Managing Director at Oilfield Production Consultants (OPC)



#### Red Adair attends SPE dinner in 2000

Red Adair, who had become world renowned for extinguishing the oil well fires in Kuwait in 1991 at the age of 75, attended a London section dinner in 2000, which coincided with my year as Chairman. Red was a memorable guest and I still have the photo of him and me on my office desk. The week after the dinner, I was stopped walking down the street in Aberdeen by a guy who had been to the dinner, recognised me and asked me to come and see him about a new project he was working on.

#### Women in Energy events

We sponsored the annual Women in Energy events for several years and I have always been vocal in promoting diversity and equality in our sector. In 2014 I shared a panel with Jane Burt, Sally Martin and Iman Hill and it was inspirational to hear how they succeeded in reaching senior positions within oil companies and raised families at the same time.



#### Milton Jones at SPE London Summer Ball in 2014

We were regular supporters of the Summer Balls and in 2014 we brought along Milton Jones the comedian. He was absolutely fabulous – and I spent most of the evening trying to remember and write down his one-liners. Unfortunately the only one I can remember is: “Anyone here have a cat? Your house stinks!” – doesn’t go down well with cat lovers.

#### Distinguished Support of the SPE award 2012

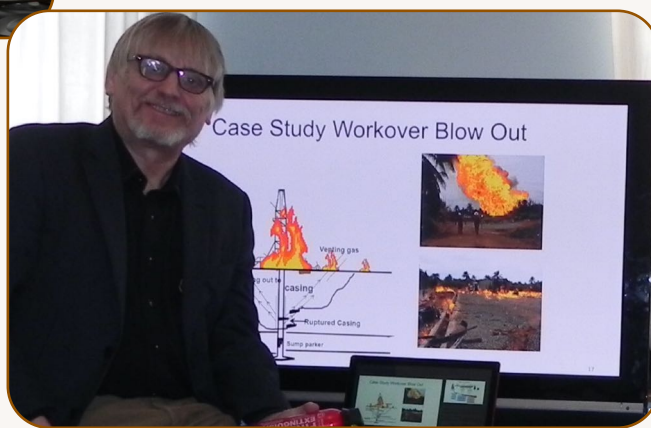
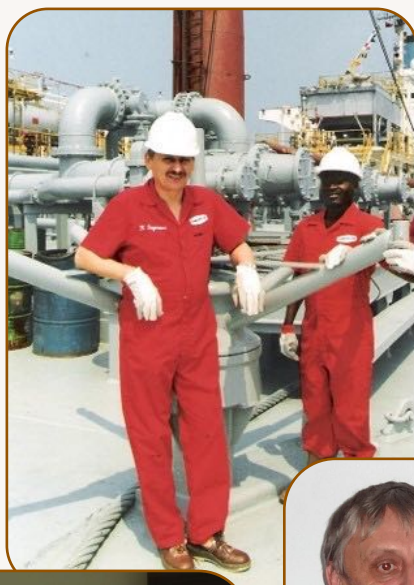
I was delighted to receive the Distinguished Support award to the SPE in 2012. Although I probably didn’t win too many friends among the majors when I said that bp and Shell should participate more in supporting the SPE and it should be them and not OPC, a small consultancy, winning the award.



## It's our 50th anniversary!! continued

### Ken Seymour, Head Of Business Development - Sub-Saharan Africa at Geothermal Development Company - CeraPhi Energy

In 1971, I was studying for A Levels, preparing for a Mining Engineering course at the University of Leeds, where in 1972, I won a Shell Scholarship. By 1974, I found myself on my first rig floor and since then my life has followed the boom and bust of fluctuating oil prices. I have travelled the world, planned and managed drilling operations, negotiated hydrocarbon concessions, sold oil cargoes, and traded hydrocarbon assets. A wonderful experience, and today my life is virtual meetings helping others develop evergreening energy resources, looking forward to my 50th industry anniversary in 2022.





# It's our 50th anniversary!! continued

John Beswick, Director, Marriott Drilling Group



**Wytch Farm appraisal drilling, 1985 (Furzey Island).**



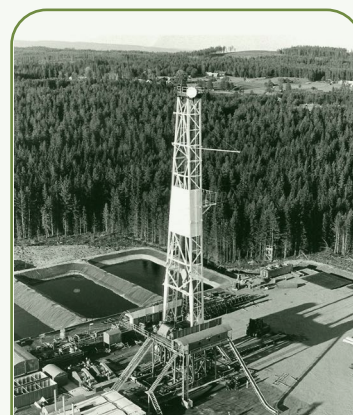
**Engineered geothermal system research Cornwall 1980-1985.** Three directional well entirely in granite. Project contributed to a better understanding of rock stress at depth and its affect on stimulation from many hydraulic stimulation phases with accurate micro-seismic mapping. The project also helped in the development of slow-speed high-torque downhole motors that are commonplace today.



**Basel geothermal well drilled in the Rhine Graben to 5001 m.** Project curtailed due to high micro-seismicity during stimulation.



**Control room at the Kola superdeep in the USSR 1991 (drilled to 12 200 m).**



**Central Sweden: Rig drilling in the Siljan impact crater to investigate Dr Thomas Gold's theory of abiogenic methane, 1986.** Well drilled entirely in granite to almost 7000 m.



**Geothermal drilling in an active volcanic area of Guatemala.**



**Switzerland - drilling and wireline coring to depth for an investigation of potential radioactive waste repository sites for NAGRA, the Swiss nuclear waste agency.** A similar 10-year programme was carried out for the UK agency at Sellafield (England) and Dounreay (Scotland) in the 1990s.



**Cuadrilla shale gas exploration, Lancashire (2012 - ...)**



**Aldbrough gas storage 2005 (8 wells for leached caverns).**



## SPE London section: **It's our 50th anniversary!!** continued



## Minister of State to speak at IOM3 energy conference

The Rt Honourable Anne-Marie Trevelyan MP and Minister of State for Energy, Clean Growth and Climate Change will give the lunchtime address at our upcoming IOM3 Energy Transition seminar in London on 12 October.



'A Material Challenge – from fossil fuels to net-zero,' jointly organised by the IOM3 Energy Transition and Energy Material Groups and will provide insight on three key areas of the energy transition – hydrogen as an alternative to natural gas, carbon capture and storage of CO2 released from converting natural gas to hydrogen, and the material challenges associated with repurposing existing oil and gas infrastructure for hydrogen use.

Each technical session will comprise three talks from practising experts followed by a moderated Q&A for informed discussion among attendees. There will also be a session led by Alix Thom, Workforce Engagement & Skills Director at Oil & Gas UK, on Transferable Technology & Skills to explore what training, skills and development are required from the UK's world leading oil and gas supply chain as it transitions to a low-carbon future.

Craig Durham, Chair of the Organising Committee, says: "It has been a pleasure to work with an enthusiastic and diverse committee to develop a seminar that will showcase the leading role that IOM3 and its members have to play in what is undoubtably the most pressing technical challenge of the next decade."

The one-day seminar will have in-person attendance in London, UK, as well as live streaming.

A poster for the seminar. It includes the title, a quote from Adrian Southworth, the date '12 OCTOBER 2021', and the location '297 EUSTON RD'. It also features logos for IOM3 Events, Energy Transition, and Energy Materials.

**A Material Challenge:  
From fossil fuels to Net Zero**

**IOM3 Events** **Energy Transition IOM3** **Energy Materials IOM3**

**'This is a great opportunity for technical professionals to demonstrate their leadership within the energy transition. Keen to hear about key technologies and understand the skills and competences needed to deliver an effective energy transition.'**

Adrian Southworth, Technical Director, OGL Geothermal

BLENDING CONFERENCE

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### A Material Challenge: From Fossil Fuels to Net Zero

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CPD hours.

Learn how existing oil and gas technology, knowledge and resource can be redeveloped and repurposed for a net zero future.



# Valuing everything: Six capitals stock model



Welcome to the London Sections' Net Zero Committee section of the SPE Review London where we will present and discuss a range of topics associated with Energy Transition and Net Zero. We hope these articles will be informative and help readers understand some of the significant changes in the oil and gas industry.

This is the sixth in a series of articles for SPE Review London covering sustainability, brought to you by Adrian Gregory who is a subsurface and wells engineering consultant. Adrian is excited to be part of and contributing to the new London SPE Net Zero Committee and will be writing future briefing articles broadly focusing on sustainability strategy, frameworks, principles, delivery and performance.

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This article will be covering integrated thinking about 'stock': enterprise governance 'stock' (primarily Manufactured Capital), Business Sustainability 'stock' (primarily Governness Capital) and the external 6 Capitals 'stock' beyond the factory area or 'production boundary'; Planetary Environs, Capitals. 'Sustainability Limits', 'Stock-of-Life', and 'Intrinsic Data' will be covered.

For those readers who want a 22 seconds outtake:

*"Capitalism is the market mechanism that delivers rewards to those who put up the Capitals Stock and those that took the risks in producing and manufacturing – delivering the Resources or Products to market, satisfying consumer demand. Market opportunities create Sustainability Value. Capitalism is, therefore, the productive use and reinvestment of the Capitals Stock. The real driving force of Capitalism is disequilibrium. The transformative power of Capitalism seeks out the best ways for Value Creation and Wealth Creation. For humanity to survive in a comparable form and with functions established to date, needs Capitalism to deliver Global Sustainability creating Sustainable Value through continual innovation and by being inclusive with good Political Governance. Previous 'market transformations' were enacted with cheap energy, abundant raw materials, and without physical or environmental limits. The current 'market transformation' will be enacted over-delivering Sustainability Value using intrinsic data and information creating greater understanding and insights into shifting demands linked to non-linear changes in consumer values & behaviours; shaped by political policies (Visible Hand of 'The Market'), emerging technology at scale, operating at physical & environmental limits and through enacting core Sustainability Practices. Our footsteps matter – particularly into wilderness stock."*

**Perfect Value** is a 'derivative' of providing Resources & Products ('Solutions') to Society without creating 'problems' for Society, for Economies, for the Environment or Political Governance – the domain of **Sustainable Development**; delivering not at the expense of others. Perfect is often described as the 'enemy of the good' so **Sustainable Development** and **Sustainability** might be the 'same meat, different gravy' – another common saying!; 'different' between 'Doing Good' based on **Needs** and 'Doing Right' based on **Desire**. We must understand what we can achieve from **Capitalism** predominantly focused on **Wealth** and what we can deliver through **Markets** predominantly focused on **Value**. Perfect Value – systemic **Sustainable Value**, at a global scale, is clearly beyond the reach of our current unsustainable Urban World life-styles needing reform of **Human Nature**, hence the next Article will be on the **Political Sustainability** opportunity. If an enterprise enacts core **Sustainability Practices** which are not in tune or as developed as they need to be, when seeking to develop reciprocal beneficial obligations amongst a wide variety of relevant Stakeholders and 'Society-at Large', this creates mutuality gaps – affecting the enterprise's **Reputational Capital**. A 'derivative' is a 'contract' between two or more parties whose **Value** is based on an agreed-upon underlying asset or set of assets (Capitals). Common underlying assets include commodities, currencies, interest rates, bonds, market indexes, and stocks. This Article will cover the integrated thinking about the firm's 'stock': **Governance Capital & Governness Capital**. **Governance Capital** is made up with the current enterprise 'stock' referred to as **Manufactured Capital** plus the Business Sustainability 'stock' made up of the remaining contingent **Governance Capital** which is not currently fully 'in-use' in 'The Market'. **Governess Capital** is the other Business Sustainability 'stock' but which is not 'in-use' or not 'valued' in 'The Market' [Figure 1, Article 5].



## Valuing everything: Six capitals stock model... continued

The **Environs Capitals** 'stock' is external to the firm, being the Capitals Stock beyond the factory area or 'production boundary'. The Sustainability **6 Capitals Stock model** within the factory area being made up of: **Manufactured Capital**, **Natural Capital**, **Human Capital**, **Financial Capital**, **Social Capital**, and **Reputational (Brand) Capital**. **Intellectual Capital**, the organisational intangible knowledge-based intellectual property, tacit knowledge, systems, procedures and protocols being cast as a subset of **Reputational Capital** in the **Sustainability 6, Capitals Stock model**.

The firm's **Sustained Value**, linked to **Business Excellence**, is achieved through enterprise **Value Creation** and **Wealth Creation** activities. The Triple Bottom Line enterprise 'flows' (Economical Social Environmental) plus 'stock' effect **Business Sustainability**. The [last article](#) on assimilating **Intrinsic Value** driven by **Dynamic Materiality**, introduced the integrated thinking behind **Total Value** ( $T_v$ ), rather than Full (Market) Value ( $F_v$ ) – hence why understanding Governness Value is so core to maximising **Sustainability Value** ( $S_v$ ) in current, next & future generations activities; total **Stock & Flows**. Through primarily **Technical Sustainability** (Principles, Strategy, Priorities, Practices and Frameworks; Delivery and Performance; Dynamic Materiality) the Stock and Flows need to be critically aligned with the current **Enterprise Value** ( $E_v$ ). **Total Value** means Technical Sustainability has to be the DNA core of the Total Value 'umbrella' of the *whole* enterprise; **Sustainability, Stewardship and Succession**.

The last couple of articles have focused on **Value Creation** and its primacy of 'individual' economic enterprise and 'organisational' economical enterprise; assimilating **Intrinsic Value**. Foundation primacy, **primacy 101** being the enterprise's need to create profits, to be profitable from existing operations; **Profit Performance** – establishing intrinsic **Enterprise Value**. Firms' **Sustained Value**, however, in the 'Sustainability-scape' has additional primacy too. Simply put, successful **Value Creation (primacy 201)** means an 'individual' or 'enterprise' can enjoy a higher **Quality-of-Life** (-Style) whereas 'individuals' or 'enterprise' that fail in 'The Market' have a low 'Quality-of-Life' (-Style); i.e. a relative 'type' index. Individual or enterprise choices based on their **Values & Behaviours** determining how much 'Value' created is traded-off between Quality-of-Life and Accumulated Value; **Capital**. This process is an integral part of **Wealth Creation**: Quality-of-Life (-Style), Accumulation & Investment – an integral part of good corporate, business and individual **Governance**. Investment and the provision of financial services being the pillar of opportunity which **Financial Sustainability** offers, creating future utility.

Circumstances change, so to maintain future resilience with similar 'Quality-of-Life' means that the competence of **Wealth Creation** is actually very important. Again, simply put, if the Capital Stock level is high and can create an equivalent **Yield**, the enterprise **Happiness** will remain similar as before, when the 'circumstances' changed. If the accumulated Capitals Stock is low, yielding poor 'rent flows' then the enterprise will have a lot less **Happiness** (even **UnHappiness**) by comparison. In fact, the redoubtable 18<sup>th</sup> Century philosopher Jeremy Bentham 'Happiness' outcome of 'Misery' would easily be equated to having no Capital (zero Wealth Creation ability) with poor to no Value Creation ability; (near) zero Quality-of-Life. These criteria: Happiness, UnHappiness, Misery, Quality-of-Life are incredibly complex so best considered in generalist contexts only; such as in terms of overall **Well Being** or an activity's **Worthiness**; whereas **Value & Capitals** can give at least more specific insight.

To assess where 'enterprise' reside in a 'Global Context' therefore usually means plotting (Y-axis, typically) 'Absolute Sustainability' (i.e. Absolute 'Happiness', typically most meaningfully represented as a function of 'enterprise' Wealth) versus Relative Quality-of-Life Index (X-axis, typically). However, **Capital** and associated **Yield** make this type of plot very subjective from an assessment point of view. First, as this article will discuss, there are **6 Capitals** in Sustainability; **6 Capitals Stock model**. If valuing Natural Capital, particularly Nature Stock, is hard enough as discussed in the [last article](#); how do you also value Human Capital where not all knowledge & understanding is traded, in-use, in 'The Market'? **Yields** also change with each Capital, and the Capitals have a dependency with each other. Yield, in terms of Value 'flows' is a function of the absolute **Value of Stock**. If the 'stock' is say a Renewable Stock (eg Wind-Farm, Solar-Park) then that Stock will still be



## Valuing everything: Six capitals stock model... continued

depreciated over the life of that asset, creating diminishing 'stock'. However, if the 'Stock' is Nature, from the **Living Commons**, then **Regeneration** has a core competitive advantage for that asset over Renewable assets.

Human 'stock' or **Human Population** does matter, with the debate going back to Thomas Malthus in 1798 where he believed that population growth would eventually surpass Nature's replenishing of **Natural Ecosystem Services & Natural Resources**. Simply put, again, when Human Population increases, so too should the Natural Ecosystem Services be increased – not decreased by humanity through its **Human Nature**. This calls for actual reform of **Human Nature** now we are living with both physical and environmental limits due to now having to produce and manufacture at a global scale; **Planetary Scale**.

As discussed in article 4, we are commercially fishing above the environmental limits of the planet's fish 'stock' Resource. With 3 million fishing boats – we have a problem, this Natural Resource is a finite 'stock' so this stock keeps dwindling and today is at record lows; the scale of the global commercial fishing fleet has definitely mattered. **Human Nature** needs 'physical' boundaries imposed and quickly, particularly where there are no **Free Rider Effects**<sup>(2)</sup> such as in International Waters & In-Space. In fact for Natural Resources, any **Wilderness** should have associated physical limits to all humanity; particularly entry points – subject to 'entry tolls' plus any additional 'fees' based on commercial intensions plus associated extent of evidence of 'non-zero trace' criteria (**Custodianship**) causing externalities. Our **Human Footsteps** matter. Imposing these **Wilderness Economic Tolls** would immediately start to re-dress the Nature & Living Commons **Sustainability Limits** keystone as well as starting action on 'Valuing Everything'.

**Natural Capital**, particularly **Natural Resources**, contributed significant **Intrinsic Value** from particularly the subsurface **Resource** in the **Hidden Commons**. These Natural Resources, exploited through wells and extracted through mines, deliver energy & matter of **Value**. "It is the availability and maintenance of this quality that determines the prosperity of humankind..."<sup>(1)</sup>. The maintenance of Stock of hydrocarbon resources drives the **Dynamic Materiality** as discussed in the last article, however, these activities are now being operated under physical and environmental limits.

Elkington<sup>(3)</sup> defined **Sustainability** as "the principle of ensuring that our (activities and) actions today, do not *limit* the range of economic, social, and environmental options open to future generations". It is clear that this 'principle' is a **Desire** to attain Sustainability, the 'destination', through endurance. Today's Economic Social Environmental TBL 'Dimensions' should make up a rich 'fabric' materiality; a **Tapestry** from which going forward is improved and enduring so that Sustainability attainment 'performance' can be 'marked'. This **Tapestry** should consistently illustrate that there is a balance between each 'Dimension', NOT a trade-off by any means. Everything has to be valued – Sustainability is all about **Valuing Everything**. As **Capitals Stock** determine our humanity's survival, our Happiness, the **6 Capitals Stock model** is the best place to start Valuing Everything; **Stock-of-Life**. Once the **Desire** to attain delivers new more sustainable **Stock-of-Life**; **Needs** can then be more easily satisfied through responsible **Political Governance**.

**Sustainability Limits** are the core element in Elkington's<sup>(3)</sup> definition of **Sustainability**. **Sustainability Strategy** is all about 'where we are now?'; 'where are we heading?'; 'how are we going to get there?'; and 'what 'limits' will we encounter on route'? ...determining the destination's (Sustainability) **3Ps: Prosperity, People, and Planet**. The 'prosperity of humankind' is determined by Natural Resources. These **Sustainability Limits** are therefore the core strategic element to the **Desire** for attaining Sustainability ('the destination') -- as **Needs** are when defining the Sustainable Development's 'prospectus' Goals.

These **Sustainability Limits** can be cast into five keystones and will be discussed in the remaining articles:

- 1: **Natural Resources** [Resource & Resources]
- 2: **Nature & Living Commons** [Natural World]
- 3: **Transformation to the Sustainability** [guided by the 'Hard' Science of Sustainability<sup>(1)</sup>]
- 4: **Valuing Everything** [Total Value; Total Stock]
- 5: **Our Values – Our Behaviours** [guided by the 'Soft' Science of Sustainability<sup>(1)</sup>]





## Valuing everything: Six capitals stock model... continued

How successful these **Sustainability Limits** are overcome on the transformational pathways to destination “True Sustainability” will dictate the future **Prosperity**; building a flourishing Natural World and Urban World (**Planet & People**).

Companies and Corporations producing at or above environmental limits will mean that **Societal Scrutiny** can only increase, particularly operating under Social License to Operate (SLO) & Societal License to Operate (SL<sub>2</sub>O) environs. **Visibility** of what companies are *actually* doing is key to staying onside with local Communities and Society-at-large. The ‘visibility’ of engineers and scientists can only increase – being best technical just got more complex. This is also driving the desire for more regenerative means particularly related to **Stock-of-Life** sourcing Resource and yielding Resources and Products. Visibility of how people live their lives and how this may change is also key; particularly reforming **Human Nature**. Enterprise will need to consider ‘wider choices’ if they want to maximise access to **Environs Capitals** beyond the factory area or ‘production boundary’. The new generation will have a very different viewpoint on the future relevance of existing legacy ‘stock’, its Resources and associated Products, its associated practices, impacts & effects; **Resource Relevance**.

Following on from **Value** definition in the [last article](#), to now address **Wealth**<sup>(4)</sup> definition which today now encapsulates **Capitals Stock**; material and immaterial, tangible and intangible. The importance of **Capitalism** built on **Capitals Stock** can then be developed. Some 140 years ago, ‘riches’ in 1886 were ‘value derived from profit’. **Wealth 1886** was therefore the accumulation, appropriation of material tangible ‘stock’ of those riches. For **Exploitation 1886**, the ‘costs of production’ were clearly defined as governed by three ‘economic’ actors:

- 1: **Nature** – raw materials, ‘free’ or economic;
- 2: **Labour** – through ‘work-done’ of ‘Production - Manufacturing’ and ‘work-done’ on ‘Capturing’ raw material **Resources** ‘removing them out of that common state they were in, hath fixed my property in them’ John Locke, 1689<sup>(5)</sup>
- 3: **Capital** – being Wealth (manufactured, ‘estate’ land or financial assets) exchanged through transactions in ‘The Market’ – earning subsequent **Economic Rent** for the owners from their asset ‘riches’.

**Capitalism** is the market mechanism that delivers to those who put up the **Capitals Stock** and took the risks in producing and manufacturing, delivering the Resources or Products (Goods & Services) to market – bearers of the rewards after the associated profits being taxed, at appropriate rates, benefiting the local Social Community & Society-at-Large. *Market opportunities create Sustainability Value. Capitalism is, therefore, the productive use and reinvestment of the Capitals Stock.* The US economist Joseph Schumpeter’s ‘work done’ consistently reminds us that the real driving force of **Capitalism** is *disequilibrium*. The transformative power of **Capitalism** seeks out the best ways for Value Creation and Wealth Creation; often overcoming Dolan’s ‘Opportunity Costs’<sup>(2)</sup>.

For humanity to survive in a comparable form and with functions as **Civil Society** has established to date, means Capitalism must deliver **Global Sustainability** by creating systemic **Sustainable Value** with continual innovation; and being inclusive with fit-for-purpose Political Governance. In fact, **Global Sustainability** is a much more superior term in all respects than any other suggested to actually fully encapsulate the Brundtland Commission’s concept ideology. That ideology became that of **Sustainable Development**, that of overcoming “(global) **limitations** imposed by the present state of technology and social organisation on environmental resources and by the ability of the (planetary) biosphere to absorb the effects of human activities”; plus adding in the need for **Political Governance** particularly for efficient & effective Capitalism – basically a four-prong approach. Conceptually, Sustainable Development was supposed to deliver a more sustainable world; **Global Sustainability**.

Free Markets today are best to source, allocate and efficiently supply **Resources & Products**; with global



## Valuing everything: Six capitals stock model... *continued*

entrepreneurialism, ‘sparked’ by Goddess Nigella aiding Entrepreneurship, ensuring continual innovation. Market inclusivity and fit-for-purpose Political Governance both require reform of **Human Nature** to achieve **Global Sustainability** (next article, **Political Sustainability**). **Civil Society** is built on V&5Cs (Values & Competence, Confidence, Courage, Collaboration, and Coherence) – forging societal relationships and partnerships; particularly with institutions, pressure groups, and business and environmental stakeholders. Current Civil Society Sustainability Limits of **Values & Behaviour** need reform. Non-excludable **Common Goods** such as Nature and Natural Ecosystem Services can be made, through Capitalism, to have their ‘stock’ less non-excludable through reducing ‘rights-of-passage’ through their ‘scapes’ stock – such as introducing **Wilderness Economic Tolls**. To change **Human Nature** will need mechanisms *conditioning individual Behaviour* and *creating Values based on Value*, but, not losing individual autonomy & free choice.

Previous ‘market transformations’ were enacted with cheap energy, abundant raw materials, and without physical or environmental limits. The current ‘market transformation’ will be enacted over new Sustainability Opportunities built on delivering **Sustainability Value**, operating at physical and environmental limits while enacting core Sustainability Practices. **Intrinsic Data** & Information will create Competence & Competitive Advantage through greater understanding and insights into shifting market demands linked to non-linear changes in **Consumer Values & Behaviours** shaped by **Political Policies** (Visible Hand of ‘The Market’) and emerging technology at scale. In Japan, this has led to the analogous thinking behind **Society 5.0**, using innovation to lead Society in a better direction, ensuring socioeconomics very similar to **Custodianship** with data as the bedrock. Societal Scrutiny will mean companies will have to do more than simply market their products but also inform and explain to consumers how they align with their **Social Oriented Business Purpose**; ‘educators’ rather than mere marketers of Products<sup>(6)</sup>. Our **Social Environmental Economical** organisational **Mission** for companies & corporations must deliver transformational change while interacting with current systems and processes; while adapting to underlying behavioural change enforced by ever-increasing physical & environmental limits as our **Human Population** continues to increase.

Market opportunity delivered **Sustainability Value** ( $S_v$ ) has two core parts:

- 1: The ‘full-on’ power house engine of **Value Creation** of ‘all things’ valued in ‘The Market’ – **primacy 201** particularly relevant with **Real Assets** and their **Portfolio Projects (Value-of-Use)**; plus
- 2: **Governance Value** (assets not valued in ‘The Market’).

**Real Assets** deliver excess economic rent and are impactful to own. Therefore ‘non-enduring value’ or ‘unsustainable value’ means that associated  $S_v$  must be declining if the enterprise, company, corporation or ‘Planetary Processes’ are unsustainable.

The insight of Jonathon Porritt’s book<sup>(1)</sup>, ‘Capitalism as if the World Matters’, means that Sustainability building from **Exploitation 1886**, can add more to this simply **Nature Labour Capital** precept of around 1886. Today’s Sustainability Stock is the bedrock of the new **Capitals Stock** ‘model for Capitalism’, as if the World matters. **Nature 1886** today is upgraded to **Natural Capital** ( $N_c$ ) – typically **Natural Resource** assets from the **Hidden Commons**; and **Nature** in the form of assets yielding ‘free’ habitat environs goods & services from **Natural Ecosystem Services** plus the **Living Commons** ‘stock’ encapsulating the **Natural World** ( $N_w$ ).

**Labour 1886** is now broken down into **Human Capital** ( $H_c$ ) – provision of the work force (competencies & skills); and **Social Capital** ( $S_c$ ) – provisions of markets (social & commerce ‘networks’) & social infrastructure plus access to public goods & services such as the **Green Commons** ‘stock’ present in our **Urban World** ( $U_w$ ). Finally, **Capital 1886** is now broken down into **Manufactured Capital** ( $M_c$ ) and **Financial Capital** ( $F_c$ ), including Land Wealth, where appropriately earning **Economic Rent** too their asset owners.

The suggestion of introducing **Wilderness Economic Tolls** are clearly one addition to reforming **Human Nature** which clearly fits well with modern day **Capital 1886** reformation. These new ‘toll’ revenues based on **Stock** access would go towards funding **Global Sustainability** precept of (global) adaptation to climate change



## Valuing everything: Six capitals stock model... continued

and mitigating biodiversity & habitat loss; and more importantly raising the **Base of the Pyramid** – a systemic approach to creating **Sustainable Value**.

What was also missed around 1886, was that Enterprise & Society are dependent on each other, leading to **Brand Loyalty** and **Reputational Value** delivering massive **Reputational (Brand) Capital ( $R_c$ )** through accumulation, appropriation of immaterial 1886 'inner' actors such as **Intellectual Capital** skills, know-how, brand empathy, etc, etc; considered intangible assets by modern Capitalist Societies. Thus, these 'inner' and 'outer' actors of 1886 have become today's **Six Capitals** of Natural Capital, Human Capital, Social Capital, Manufactured Capital, Financial Capital & Reputational (Brand) Capital.

**Reputational Capital** – intangible value and 'Brand' wealth is regenerative through Succession. **Outputs** (primarily from strategic and core competencies) are the traditional value-adding competences. But the **Outcomes** from the activities and actions of the business, primarily through 'events' from more societal or environmental dimensions as well as economic from market and partnership disruptions – affect wealth. Outcomes typically reflect the impacts and effects of their activities and actions. **Outtakes**, typically related to **Corporate Governance** and often are covered, developed through social media outlets and therefore have grown in importance as these platforms have matured to the full penetration of society, at global scale. Markets will broadly allocate Resources efficiently and desire should deliver a full Governance Value – therefore good articulation that commerce, enterprise and industry are really doing important things is very important for achieving additional Sustainability Value tomorrow and in the future. Articulating the **Purpose** of the company; how they are organized to do things and what they are seeking to do. Intangible **Performance** is accessible through Corporate reports, videos, webinars and seminars plus more traditional print media such as through technical journal papers and through the eyes of journalists and media commentators. Benchmark studies more often now have a higher percentage of intangible analysis to create differential assessments.

**Corporate Governance** issues operate within well-defined and accepted structures – accountability between directors and shareholders; profitability; risk identification and assessment; risk management; formal & informal networks and relationships; compliance; transparency; and Annual Reporting, both Financial & Sustainability. The roles, rights and responsibilities of corporate directors are vital. In particular, the board of directors is the most appropriate body to allow and design internal 'policies' to enable Corporate Governance to fulfil their responsibilities to shareholders, stakeholders and 'Society-at-Large'. Without legal regulation of Corporate Governance – **Codes of Conduct** have appeared prominently, particularly in Reputational Brands.

**Natural Capital** Stock, as presented [in the previous article](#), can be either the estimated subsurface **Resource** [HIIP] or the estimated surface deliverable/recoverable **Resources**. These estimated 'surface' recoverable **Resources** can be represented in the form of **Net Present Sock ('NPS')** when considering the Resources deliverable from **Hidden Common** Resource, subsurface stock [HIIP – Hydrocarbons-Initially-In-Place].

Pre-2014, **Contingent Resources** were deemed by 'The Market' to have an associated current market value, but not their full market value. Typically in an acquisition at that time, Contingent Resources were valued at their sunk cost; accounting book 'value' plus any necessary associated commercial value premium, resulting typically in around 10% of their future full value at project board sanction, with full regulatory approvals. However, because Contingent Resources are not actually deemed 'manufactured', they are categorised as **Natural Capital** – not **Manufactured Capital**, in the Sustainability 6 Capitals Stock model. Past peak oil demand and increasing Societal Scrutiny, valuing Contingent Resources will result in lower market valuations as these resources could see their development significantly delayed – stranded resources being 'moved back' in the Stage Gate (Review) process into Speculative Resources. Hopefully in the future, company bookings of Resources & Reserves will be better linked to the well documented and near universally applied **Stage Gate Review** process.





## Valuing everything: Six capitals stock model... continued

**Manufactured Capital** is the physical, tangible assets owned, leased or controlled by an organisation (enterprise) that contributes to the production or service provision; delivery supply of Resources and Products. 'However, manufactured capital is not quite as simple a concept as it sounds. It is made up of the material goods (assets) that contribute to the production (and manufacturing) process, but do not become embodied in the (day to day) output of that process.'<sup>(1)</sup> Therefore for Natural Resource companies, their **Resource Stock** is deemed part of **Natural Capital**, but their **Reserve Stock** and **Production History** is part of their **Manufactured Capital**. **Reserve Stock** is typically an annual Audit Evaluation of future deliverable profile forecasts. Daily or weekly **Production**, however, being precisely measured and audited as part of the 'output' of the production (and manufacturing) process. As wells, mines & their associated infrastructure are clearly part of Manufactured Capital, the enterprise 'work-done' in creating their physical stock 'hath fixed my property in them' including the expected **Reserves Stock**. If the enterprise was a gold mine, its gold Reserves held in the bank would be 100% physical, tangible manufactured assets; held in store. **Resource Stock**, however, are natural assets without associated physical production infrastructure nor have Regulatory or Board approval to be developed. Associated 'work-done' being focused on 'accumulation delineation' of Net Pay, 'recovery factor certainty' based on envisaged associated Production Well Stock and 'commercialisation' of Economic Resources [Figure 1, Article 5].

**Human Capital** addresses the attributes of individual associated skilled enterprise.

"**Human Capital** is not owned but rented. In Marxist terms, the means of production are now inside the heads of the workers. As a result, investment in the (collective) intellectual capacities of employees is a serious priority for successful companies, not least because of the powerful evidence that it generates significant returns".<sup>(1)</sup>

'Features of social life (-styles)' in social structures, encapsulated in the Urban World's **Capitalist Society**, refer to many such as institutions, markets (social & commerce networks), relationships, partnerships, values, level of participation, reciprocity and community cohesion. Some now being nuanced into 'Bridging' & 'Bonding' **Social Capital** attributes – inclusive or exclusive.

"Advocates argue that such mutual support, trust, and the ability to work together (families, communities, societies) to solve common problems contribute as much to a country's success as do its material resources (Natural Capital and Manufactured Capital) or the skills of its population (Human Capital). Consequently, they have dubbed these attributes **Social Capital**".<sup>(1)</sup>

**Financial Capital**<sup>(1)</sup> is complicated because it is the main 'means' to exchange the benefits from other Capitals. **Financial Assets**, like stocks of money, bonds and equities have no value in themselves – they are simple 'derivative' of underlying associated stocks, as highlighted at the beginning of this article. **Political Governance** of macro-economic stability & performance can affect these Financial Assets' future yields. Through markets' **Imperfect Information**, Financial Capital also plays an important role in the production, manufacture and delivery of Resources & Products – through 'provision of financial services' from stocks of specialist information and expertise particularly linked to **Financial Risk**; and often important **Risk Transfer** services to help mitigate possibilities of bad debts arising in the future. A third importance of Financial Capital is the economies **Money Supply** which is created not linked to the real Resource use-in 'The Market' or to amounts of Resources & Products 'flowing' in the economy – but – based on entirely the commercial judgement about the individual or organisational enterprise's ability to repay their loans. **Assimilated Value**, accumulated as Capital is the purest – easiest form for use in 'The Market'.

For those who struggle that the aspect of these Sustainability Capitals (such as Human Capital and Social Capital) being thought, defined, incarcerated in such a stark 'accounting' 'audit driven' terminology then hopefully the following additional 'descriptors' may help – remembering that it is the productive use and reinvestment of the Capitals Stock that defines **Capitalism**:



## Valuing everything: Six capitals stock model... continued

*Natural Capital* ( $N_C$ ) is the '**Store of Value Stock**'; living and non-living material assets. Precious paintings and other artefacts have similar sort of **Intrinsic Value**. Because these 'store' items are so valuable they need **Stewardship** to fully understand, nurture, define, characterise, estimate the flow capacity and yields from the Resource; where the **Stock** can be sourced at the **Store**.

*Manufactured Capital* ( $M_C$ ) is the '**Tool Box of Value Stock**', assimilated tangible 'stock' which is able to collectively craft within the 'production boundary' and ready to aid deliver to consumers.

*Human Capital* ( $H_C$ ) is the '**Value of Labour Stock**', intellectual & work done 'individual' abilities & capacities, built on experience; competencies & skills learnt.

*Social Capital* ( $S_C$ ) is the '**Value of Community** (large or small) & **Consumption Stock**'. Relationships, Partnerships ensuring commerce and markets to perform to the co-benefit of the **Urban World** ( $U_w$ ), and now hopefully the **Natural World** ( $N_w$ ).

*Financial Capital* ( $F_C$ ) is '**Liquidity Value Stock**', representative – having no value in itself at scale without markets. The latter is often described as the 'enabler of projects' – creating new assets; lubricating the whole Value Creation & Wealth Creation process.

*Reputational Capital* ( $R_C$ ) is '**Competence Value Stock**', which includes intangible 'collective' Intellectual Capital Stock, plus additional Resource and Product Value representative Stock built around Brands, Relevance to Consumers, Preferences, Strategic Communication; overall additionality of the **Value<sub>2</sub>People** Sustainability thematic.

**Primacy 301**, modus operandi means that external **Environs Capitals** could become engaged by the enterprise through having a **Social Oriented Business Purpose** -- wishing to create more value by leveraging these additional external capitals; enhancing the current **Enterprise Value**. **Corporate Governance Value** ( $CG_v$ ) creation is driven by the wish to achieve the corporation's full market value (ie Governance Value), needing access to these external 6 Capitals Stock plus consumers having full desire. However, **Societal Scrutiny** is also gaining momentum and is becoming a required process to instigate in order to get harmonious access to this **Environs Capital**. Society is well adverse with the **Natural Business Curse** and arising costs to them from commercial activities, actions and non-actions at the expense of others. Business Sustainability is built on **V&5Cs** (Value & Capitals, Connections, Cooperation, Collaboration, and Co-organisation) – forging business relationships and partnerships; particularly networking within local communities, with trade associations and political pressure groups.

If society is going to 'invest' their **Social Capital** & associated **Environs Capital** into enterprise activities, the enterprise cannot simply say, "trust-us, we will look after your capitals". Society has a very strong association with "their" Capitals. When they have given 'best steward' status through **brand loyalty** – society feel they have ownership where none actually exists in law. This is very similar to shareholders in Coca-Cola Ltd thinking that they can then go to any of the global branded dispenser machines and take out 'their' can free of charge, from that 'stock'. National sovereignty is very similar, UK citizens feel that Gibraltar and the Falkland Islands are "ours" – yet most have never been to visit these assets. The national bond however is very strong. So society feel not only 'their' **Social Capital** is invested in business, so is 'their' **Human Capital**, etc. Most societies, particularly indigenous people, feel the **Natural Capital** is 'their' Capital too. UKCS oil & gas Resource & Resources are only licensed to operators. The Crown Estates appropriating their ownership from our Civil Society – through legal monopoly of assets. UK citizens only own their land assets to 50ft below the surface, and some 500 - 1000ft above ground level. This 'space' or 'stock' above 1000ft, particularly 'In-Space', has interesting potential to generate new **Planetary Revenues**, without **Free Rider Effects**<sup>(2)</sup>, from proposed **Wilderness Economic Tolls**.

Institutional **Financial Capital** awarded to business through national governments have very strict



## Valuing everything: Six capitals stock model... continued

governance, accountability and auditability – hence the new Industrial Hubs, ‘Visible Hands’ of ‘The Market’ responding to externalities will have full Societal Scrutiny – as Heathrow Airport expansion plans have fully witnessed. Even though society does not actually have powers to ‘own’ their Capitals Stock – they can cause severe financial distress if they withdraw their **Reputational Capital**; putting pressure on other companies to withdraw their **Manufactured Capital** from associated projects. Corporations producing at or above environmental limits will mean that Societal Scrutiny can only increase through **Due Diligence & Mastery Audits** with companies & corporations having to consider ‘wider choices’.

The firm’s **Governance Capital** ‘stock’ builds from the accumulation, appropriation of **Governance Value**; made up of predominantly **Existence Value** and **Future Value** (Article 5). For Natural Resource companies, this Governance Capital includes Speculative Resource (Existence Stock) and Prospective Resource and Speculative Prospective Resource (Future Stock). In the **6 Capitals Stock model**, Natural Resources & Reserves are split into **Natural Capital** and **Manufactured Capital** as discussed. **Natural Capital** includes all the Resource Categories (ie Contingent Resource, Speculative Resource, Prospective Resource & Speculative Prospective Resource) [Figure 1, Article 5]. **Manufactured Capital** includes all the commercially proven **Governance Capital** Reserve Categories (ie proven developed and proven undeveloped **Reserves**). So treatment of ‘Value’ and ‘Capitals’ needs technical care as Reserves Stock are not considered a subset of Resources Stock in the **6 Capitals Stock model**. **Manufactured Capital** is the current, collective Stock ‘fully earned’ through ‘work done’ - ‘removing them out of that common state they were in, hath fixed my property in them’ creating associated full manufactured ownership of the **Reserve Stock**. **Historical Production** is also classed as part of Manufactured Capital – tangible **Intrinsic Data** [Figure 1].



Figure 1: True sustainability



## Valuing everything: Six capitals stock model... continued

Porritt's notion of Capital is "a **Stock** of anything (physical or virtual; material, energy, information, intrinsic data) from which anyone can extract a revenue or yield"<sup>(1)</sup>. What is functionally important is the relation of a 'stock' yielding a 'flow'; a 'flow' of valuable goods or services now and into the future. Whether the Stock is 'Manufactured' or 'Natural' or 'Financial' or 'Human' or 'Social' is in this view a distinction between different kinds of Capitals and not a defining characteristic of the Capitals themselves. Capitals Stock should not to be confused with the 'flows' they produce as the **Stock** represents today's **Wealth**, not tomorrow's or future generation 'flows'; total Governance & Governness **Capitals Stock**.

Associated enterprise **Capitals Stock** do need to be understood in all firms, particularly corporations. How is their associated Value created? Where is Wealth created? Where are the Sustainability Opportunities? Guiding where to change Sustainability Priorities and Sustainability Practices. Porritt<sup>(1)</sup> helps us through the Capitals Stock insights on **Table 1**, breaking down simply the Stock benefits to Business & through Societal Benefits. If enterprise **Social Oriented Business Purpose** ('SOBP') has enterprise **Sustainability Practices** in

Business Sustainability	Benefits to Business	Sodetal Benefits
Natural Capital	Enhanced Reputation	Security
Social Capital	Stronger Brand Preference	Cohesion
Human Capital	Market Advantage	Improved Quality of Life
Manufactured Capital	Risk Reduction	More Opportunities
Financial Capital	Options Creation	Wealth – Needs Met
Reputational Capital	Purpose – Social Oriented	Global Sustainability
[Capitalism - As if the World Matters, 2007, p276-277]		

Table 1

tune, **Reputational Capital** should become a major contributor to improve future Stock.

If the **Carrying Capacity** of the Capitals Stock is sufficient to produce 'flows' of goods and services to meet the needs of the Urban World and the Natural World – the Stock 'Carrying Capacity' is sufficient. Global activities and actions are 'Sustainable' when their impacts and effects on these Capitals Stock either do not diminish, or is maintained and/or creating at sufficient levels of associated carrying capacities. Whereas regeneration in the Natural World is a core competency, the Urban World has yet to fully embrace or master such competence. New Urban World skills will need to be developed at global scale if the limits to the **Transformation to Sustainability** are to be overcome; achieving **True Sustainability**.

Consumption **Behaviour** is very much on the **Sustainability Limits** 'radar' needing reform: collective **Values & Behaviours**. The limit of **Transformation to Sustainability** mean, the means of production will evolve into the new utility **Capitals** for the next and future generations. There are four key 'structures' which will have to be overcome: **Power Structure**, **Value Structure**, **Cost Structure** and **Delivery Structure**. **Re-Architecture** of these real structural 'barriers' need to occur – primarily addressed through current **Values & Behaviours** ("the future is now" Sustainability thematic).

**1: Power Structure** is the *in-Vested Interests* where threats and limits to **Economic Growth**, to current activity 'Interests' mean Governance & Management (the advocates of the current Capitals 'Stock') block, impede and generally misinform the need for change.

**2: Value Structure**, is a newer construct, where *in-Vested Capitals* (Human Capital, Manufactured Capital) literarily due to emerging threats and limits to Creating Value, effecting the lives that have been invested in the Capitals Succession, pressgang, impede and generally un-inform the need for



## Valuing everything: Six capitals stock model... continued

change. The later usually is cast through representing total possibilities, not economic possibilities, seemingly unaware of the importance of having Goddess Nigella ‘sparking’ entrepreneurialism, aiding **Entrepreneurship**.

**3: Cost Structure** is the management ‘elephant in the room’, where Full Costs, Cost Barriers and Profit Focus means ‘Costs’ or ‘Flows-Out’ from Corporate Budgets become line items of internal financial scrutiny – hence game-full employment to delays, procrastination – often while ‘Rome is Burning’. With cumulative issues, the only true way is ‘front-end’ loading – completely against orthodox, conventional management practices. The ‘Invisible-Hand’ of ‘The Market’ does not cater to ‘limits’ – particularly environmental limits.

**4: Finally, Delivery Structure** built on Technical Perspectives: Activities, Design, Grande Design – Doing (Technical) Work. Without clear pathways and planning for the future utility, additional risk such as **Elephant Risk**, naturally impedes the direction, momentum and ultimately the speed towards the future. Government Policy & Regulation can help but needs leaders – not just leadership. The ‘Visible Hand’ of ‘The Market’ needs to deliver too. With environmental limits to growth in traditional sectors, the chance of investing in projects which fail at conception, selection, design, during early operations or having premature lifetimes only increases in-tune with increasing **Societal Scrutiny**.

Adam Smith stated that one of the sacred laws of justice was to guard a person's property and possessions. Protecting *in-Vested* assets is a natural response to threat. So overcoming Human Nature needs reform which in the history of our Planet has not been achieved before; is humanity up to this challenge? The Natural World has not been. **Re-Architecture** of these real structural ‘barriers’ needs to occur; ‘tilting the playing field’ is achievable through transparent **Political Policies**.

An economy’s **Inclusive Wealth** is the accounting current **stock-of-assets** – assets that provide goods & services:

- 1:** Manufactured Capital: buildings, machines, equipment
- 2:** Human Capital: knowledge, aptitude, education, skills
- 3:** Natural Capital: fossil resources, minerals, forests, agricultural land, rivers and estuaries, the atmosphere and the oceans – ecosystems more generally – as well as subsoil resources.

**Durable Assets** like knowledge, institutions, culture, religion – a nation’s **Social Capital** – are taken to be **enabling assets**. That is, assets that enable the production and allocation of a nation’s Manufactured, Human and Natural Capital (Natural Resources & Nature Capital & Ecosystem Services).

The productive base of the economy, the **Production Assets** provide the types of Capitals which lead to the ultimate purpose of an economy – **Social Well-being**. To work out the **Social Value** of an asset you need to total up the goods and services that a society obtains from it. This allows us to determine how the well-being of a society is affected by an asset. A mangrove forest, which is an example of an asset, is a habitat for fish that we then eat. It is also a source of timber. And it protects people from storms and tsunamis. Likewise, an economy's institutions and politics are factors that determine the social value of its assets because they influence what people are able to enjoy from them. Assets are **Stocks**, not **Flows**. They provide us with goods and services, which are flows. A tree is a stock; its fruit is an annual flow of goods, while its leaves – by inhaling carbon dioxide – provide a continuous flow of ecosystem services. Putting a price on these assets allows us to measure an economy’s real wealth, its true well-being.

For some **Environs Assets**, beyond the factory area or ‘production boundary’, such as **Nature Stock**, are hard to ‘value’ – even though Nature creates Natural Ecosystem Services ‘flows’. By having a valuation of their corresponding Nature Stock, their Capital-Wealth ‘value’ can then be assigned to these Natural Assets. Once

## Valuing everything: Six capitals stock model... continued

this Capital-Wealth ‘value’ is assigned, we will understand what the corresponding ‘Social Price’ would be as a yardstick for **Citizen Investors**<sup>(7)</sup> to assess their activities, actions and non-actions. Hence achieve better resource allocation by free market economies. For Nature Stock, the ability to actually value everything is in its infancy hence this whole capability is one of the five keystones of Sustainability Limits. Even valuing aspects of Human Capital and Social Capital which are not traded regularly are hard to ‘value’ consistently.

When integrating thinking about **Valuing Everything**, the current **stock-of-life**, it is more important to consider **Capitals Stock** and not just **Inclusive Wealth’s** current ‘stock-of-assets’. The **Planetary Stock Balance** can be expressed very simply by **Equation 1a, 1b**:

$$U_w + N_w = N_c + H_c + S_c + M_c + F_c + R_c$$

$$1 = [(N_c + H_c + S_c + M_c + F_c + R_c) / U_w] - [N_w / U_w]$$

**Equation 1a, 1b: Planetary Stock Balance [Stock-of-Life]**

**Urban World ( $U_w$ )**

**Natural World ( $N_w$ )**

The Living Commons used to represent some 62% of the Planet in 1960, now only some 35% in 2020 according to Sir Richard Attenborough<sup>(8)</sup>; so  $N_w/U_w$  has decreased from around 1.6 to 0.5, falling fast! For the remaining term, as the Urban World ( $U_w$ ) increases in ‘stock’ (valued & waste/abandoned) it becomes obvious that out of the **Capitals Stocks** ( $N_c, H_c, S_c, M_c, F_c, R_c$ ) only **Natural Capital** and **Reputational Capital** have significant regenerative capital needed to obey the Laws of Nature and that the **Urban World** too needs to be sustainable.

**Capitals Stock** assets which the Urban World rely on for ‘stock’ **yields** to sustain Humanity and to replenish and regenerate (**Dynamic Materiality**) now and for future generations are not in-balance. The Urban World has had its ‘best of times’; the Natural World has had its ‘worst of times’<sup>(7)</sup>. The Urban World, particularly individual and organisational enterprise needs to take the ‘primacy of stock’ (**primacy 401**) very seriously! Can the Urban World’s commerce really ‘live in harmony’ with Nature or should the Urban World and Natural World be separate entities as depicted in **Equation 1a; Planetary Boundaries** respected. Sustainability is about enduring Practices, Processes, Systems & ‘Stock-of-Life’ – so this discussion needs to happen soonest.

**Information** is key to help society attain to realise the great complexity of these Sustainability Limits, particularly as scientific experts can often have a narrow view. Capitalist Society now is very much entering the ‘Data Age’, evolving through succession of the prior ‘Information Age’. **Sustainability Performance** is just one domain that will benefit from this new ‘Data Age’. Good metrics need good data, etc, etc. Performance needs consistent data over subsequent reporting periods – Net Zero pace attainment is key. Current Annual Sustainability Reporting seems to only concentrate on past performance data through the ‘eyes’ of Corporate Governance; surprisingly not including more current and forward data – particularly related to next and future generations – through the additional ‘eyes’ of Governness, rather than simply Governance.

**Intrinsic Data**, in particular, will create Competence & Competitive Advantage through greater understanding and insights such as shifting market demands linked to non-linear complexity. Socioeconomic analysis needs better data too, particularly **Quality Data [Custodianship]** to help new specialisms develop their ‘tools-of-trade’. Assets with **Intrinsic Value** do have bedrock **Intrinsic Data**, captured primarily through observations & measurements on those assets stock. That data is predominantly stored today digitally which has caused increased research into **Big Data** analytics. Intrinsically valuable data represents more than just a representation of an observation/ measurement or a ‘symbolic quality’ but is **Data-of-Value**, independent from market circumstances and should have enduring value now and into the future as long as the associated landscape domain stays relevant. **Historical Production** is a good example of Intrinsic Data and was cast in



## Valuing everything: Six capitals stock model... continued

**Figure 1. Historical Well Data**, representative of local Hidden Commons' architecture and properties also is another good example of Intrinsic Data. **Data-of-Value** has utility which often through the 'hands of specialists' can arise to serve a purpose; create assets with Value-of-Use; cause and help invention & innovation; aid exploitation & extraction of Natural Resources. **Intrinsic Data** can also be 'packets' of 'ideas' 'communication outtakes' 'concept sparks'. Whereas we have spent the last fifty years understanding the packets of 'oil & gas molecules' – the Data Age will focus more on these intrinsic packages of Data-of-Value.

The key to understanding the value of **Intrinsic Data** is understanding **Precision**. These data clusters with 'precision' then have 'consistency' or 'certainty of reliability' thereby achieving a 'target of influence' in the associated landscape domain's space. However, **Precision** of 'measurement' also needs calibration to get **Accuracy** – the 'certainty of aim' based on experience & calibrated 'tools-of-trade'.

**Deep Data** is basically 'Big Data with Theory', precision data with a rich data cluster creating certainty of reliability – delivering, achieving 'Being Right' with calibration sufficient giving the required accuracy. **Small Data** is needed to acquire accuracy based on experience & calibrated 'tools of trade' delivering "fit for purpose" predictions. **Big Data** is actually **shallow data**, clustering without certainty of precision nor accuracy. Without theory, Big Data, therefore, needs 'assisted learning' based on experience or needing constraining with use of accurate Small Data.

**Quality Data** has features and clusters, reference 'points of context', calibration points, maxima & minima and have been used by specialists to calibrate their 'tools-of-trade'; competence. Once the Quality Data has been incorporated in these 'tools-of-trade', these tools become the valued 'asset' rather than the associated 'Quality Data'. **New Data** through data acquisition is always precious from the Hidden Commons, but, often its value can only initially be seen as Data-of-Value by experienced specialists.

If you only have 'one shot' – then you had better be accurate, rather than just being precise or without certainty of both, as from Big Data. If you have 'multiple shots' you will figure it out eventually, through **Standards of Performance**. Global Sustainability means industrial and agricultural sectors will have 'multiple shots' – hence Standards of Performance are key. 'Upscaling' data, then 'Downscaling' data, were big challenges some 30 years ago in Reservoir Characterisation. No theoretical solutions were found, except exceptions. The way forward then was to simply resolve through Standards of Performance or to simply run larger Reservoir Simulation models, eliminating the need (& often debate!).

The same will be true today for **Big Data** 'hype', it can be reduced in discussions by simply getting more **New Data** (infilling the gaps) & **New Learning** (more theory). Beware of the 'Emperor's New Clothes' – a little knowledge and a lack of experience can be very dangerous. Eliminating 'bias' is 9/10<sup>th</sup> of the Law to achieving **Accuracy**; Being Right. There will always be exceptions vs rules (laws) but Intrinsic Data is a good place to start. Big Data will find its place in the subsurface technical landscape domain, but, so far this has been predominantly an advocates' domain for addressing very niche & bespoke surface technical applications. Subsurface earthquake data lacks precision and accuracy – so good place to start!

Jonathon Porritt's book<sup>(1)</sup> simply 'speaks' authority – particularly built on his unique insight and his first hand experience of the politics and advocacy of environmental issues. In 1992, Stead & Stead suggested we were rapidly reaching the 'environmental' crossroads. Jackson, twenty years later explains 'at that crossroads' why Sustainability is so important. Porritt has shown eminent leadership in Sustainable Development and Sustainability since the 1970's earning his right to eminent roles in all the best of institutions. His book simply states the obvious, but, in a manner that does not offend.

To save Humanity through **Capitalism**, firstly, Porritt points out that political NIMTOs ('Not In My Term of Office') needs politicians to step-up and to actually consider the longer term, particularly addressed through **Political Policies (Political Governance)**. Climate change effects the poorest and most vulnerable of our Urban

## Valuing everything: Six capitals stock model... continued

World and the Natural World. The Urban World **unhappiest**, or Jeremy Bentham's most 'miserable', certainly matches with this 'poorest' characterisation. The Sustainable Development Goals – **Doing Good (Political Sustainability)**, the topic of the next Article) effects all **Urban World** consumers – so if National Security (ie Defence) is worth expensing 2% of National Income, then, surely similar by comparison should be worth expensing on the poorest of Humanity (**Base of the Pyramid**) and the **Natural World** effected through biodiversity & habitat loss. **Security** just needs its meaning to be reformed. **Doing Good** based on **Needs** cannot be underestimated, globally. Key is delivering what Politicians and Society-at-Large want to happen due to the increasing 'happenings'. The **Human Development Index** is one good means to determine the sovereign nations corresponding level of contribution to the **Sustainable Development Goals**. But, where is the integrated thinking around **Global Sustainability** resourcing from **Planetary Scale** economic considerations, sourced from **Stock** using or crossing International Waters & Global Cover. Imposing 'In-Space Rent' could be very timely as **Space** exploration has now moved into appraise & demonstration projects; the new frontier. Similarly charging those who wish for 'passage of entry' to Rain Forests, Coral Seas, and Arctic Polar & Tundra wildernesses – ensuring zero waste, zero trace from **Human Footsteps**, through **Human Behaviours**, is also now timely to emerge from previous embryonic, but **Planetary Integrated Thinking**.

Secondly, the necessity to obey the **Laws of Nature**, the Urban World has to live sustainably too on this Planet with increasing **Human Population & Human Pollution**; this side of many scientific predictions by experts of our extinction by many focusing on the '2 minutes before midnight'. **Human Population** increases simply must be matched by corresponding increases in **Natural Ecosystem Services**; simple. This requires **Planetary Integrated Thinking & Planetary Action**.

Thirdly, the political imperative, **Political Policies** through Political Governance, needs to aspire to that the Urban World must improve *our* material 'standard of living', year on year. This will need **Doing Good** and the desire of **Doing Right** at a global scale. These imperatives have never been more urgent even since Porritt's book was first published. SDGs, which did not exist when Porritt was completing his contribution to Capitals Stock, are now cast in stone so the means for redefined 'global aid' (**Global Security**) – the **Needs**, are in the political 'headlights'.

**Utility** to get out of the crisis our unsustainable Planet is in right now means **Value** can and will only increase as long as **Capitalism & Markets** survive through an enduring **Capitalist Society**. **Valuing Everything** ensures Total Intrinsic Value is valued; not just Enterprise Value (Current Market Value) or Governance Value (Full Market Value). Governness Value matters too. Humanity needs to value 'everything-of-value', Values of Value (s)<sup>(9)</sup>. Reform of **Human Nature** is key to achieve Global Sustainability. Additional utility from regenerative **Natural Capital** (particularly Nature, Biodiversity and Habitats) & **Reputational Capital** (built on Succession & Stewardship) are the real opportunity that the **Technical Sustainability** pillar offers, now and in future generations. Additional utility means **Capitals Stock** can only keep increasing, driving **Prosperity** forward – but maybe not growth as 'we know it' before; in our rear mirror now. **Business Sustainability** is 'full-on' Value Creation focused and driven also by **Dynamic Materiality** and **Stock Governance & Governness**; the 'stock-of-life'. The main question today is will **Wealth Creation** still flourish in the next generation – new utility matters.

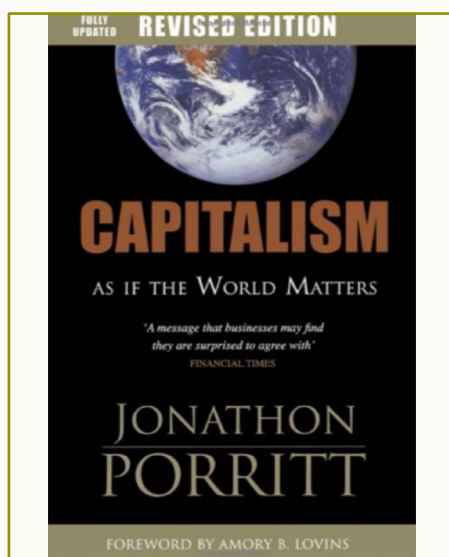
Today's Urban World **Capitalist Societies** need good representative **Political Governance** to ensure the interests of the future (Governance & Governness; core to Sustainability and Sustainability Value) are delivered through **Markets** in a timely manner, in the present and tomorrow. This will need 'tilting of the playing fields'. As this and previous Articles have discussed, the current **Technical** perspective **Wealth Creators** need to achieve 'Transformation to Sustainability'; re-architecting through their real structural protective 'barriers' as the new reality dawns, often in unison with their 'darkest hours'. Future **Wealth Creation** through 'transition built utility' is as uncertain as the ultimate future destination; **True Sustainability**, even if the desire is strong. **Succession** is the foundation on which the 'transition built utility' is built on. The future will

## Valuing everything: Six capitals stock model... continued

tell us which **Sustainability Limits** need to be re-engineered, guided by the **Science of Sustainability – Technical Social Environmental**.

Based on these 6 Articles, the **Sustainability Mission** can be best summed as “*the desire to produce, to manufacture, to deliver **Sustainability Value** through endurance and limits, physical & environmental, attaining **Global Sustainability** creating **Sustainable Value** built on **Capitalism** (the productive use and reinvestment of the **Capitals Stock**) overcoming limitations imposed through continual innovation and by being inclusive with good **Political Governance**”*. **Mission Critical** is to reduce our Urban World **Footprints** and our Human **Footsteps**, reforming our behaviour while restoring **Natural Ecosystem Services** in line with **Human Population**; renewing **Natural Resources** and maximising the regenerative **Nature of the Natural World**.

Article 7 in the next issue of SPE Review London will be covering the second perspective, **Political Sustainability**, with its pillar of opportunity ensuring the interests of the **Capitalist Society** needing **Doing Good** and the desire of **Doing Right** – achieving **Global Sustainability** through **Capitalism & Markets**. Political Sustainability & Base of the Pyramid; Sustainable Development Goals.



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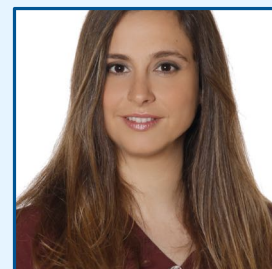
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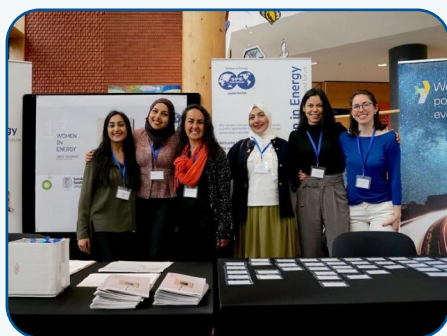


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