Sompo Digital Laboratory EMEA

THE GIRAFFE'S VIEW
Conversations on technology, risk, and innovation

Colin McCulley on leadership and a new primary energy source

A conversation with Srikanth Madani, Head of Innovation, EMEA

Conversation guest

Colin McCulley

SVP Americas Operations & Business Development, Vema Hydrogen

Colin McCulley is Senior Vice President at Vema Hydrogen, a U.S.-based energy technology company developing engineered mineral hydrogen (EMH) — an approach that accelerates naturally occurring subsurface reactions to produce low-carbon, scalable hydrogen.

With a background in petroleum and reservoir engineering, Colin has spent his career in upstream and midstream energy operations, leading drilling, infrastructure, and subsurface development projects across the United States. At Vema, he applies that experience to commercializing geologic hydrogen as a new primary energy source capable of competing with conventional fossil fuels on both cost and emissions.

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Broad themes of conversation: Leadership; Energy Transition; Low-Carbon; Hydrogen

A career built on energy and transition

Srikanth: *Colin, thank you for taking the time for this conversation. Could you introduce yourself?*

Colin McCulley: Sure. Thanks for having me — it's great to talk with you. My name is Colin McCulley. I'm a Senior Vice President at Vema Hydrogen and one of the first employees of the company. We're a startup developing technology to produce low-carbon hydrogen through a fundamentally different pathway, and we're excited about what that could mean for the energy industry.

Srikanth: *What does it mean to be one of the first few employees at a company? Is your employee number in single digits?*

Colin McCulley: Yeah, I don't think we have employee numbers. We're a startup, so our HR is still a work in progress. I was speaking with the founders, Florian Osselin and Pierre Levin, before the company was officially founded. There was a venture studio involved early on, and I was part of those initial discussions.

The technology was so exciting that I started working with them even before the company formally existed. Once it was founded, I came on full-time. I'm essentially the first employee outside the two founders.

From oil to hydrogen: a professional evolution

Srikanth: *Before we dive into Vema's technology, could you walk us through your professional journey?*

Colin McCulley: I'm an engineer — petroleum and reservoir engineering from the University of Texas at Austin. I started in traditional energy, working at BP and then at smaller companies. Over time, my career kept getting pulled closer and closer toward the energy transition. That's just the direction the industry has been moving in.

I started in upstream oil production, then moved into midstream infrastructure. At Sanchez Oil & Gas, we formed a company to manage midstream assets, which evolved into a broader energy transition infrastructure platform. Later, I worked on Daylight Petroleum, focused on conventional U.S. oil assets. We grew quickly — more than 100 people and over $400 million in assets. One of our crown assets was a CO_2 flood project. Originally, we bought it because it made money. But as the policy environment evolved, we began recertifying it to qualify for carbon sequestration. That was another pull toward transition.

After that, I founded Farallon Lithium, focused on lithium brine exploration. That venture didn't succeed, but it deepened my exposure to subsurface energy transition resources. While working on that, I began conversations with the team at Vema — and here we are.

Lessons from the energy industry: past, present, and future

Srikanth: *You mentioned a CO_2 flood project. For those unfamiliar with the term, could you elaborate?*

Colin McCulley: A CO_2 flood is a method of enhanced oil recovery. When oil production declines because reservoir pressure drops, you inject fluids to add energy back into the system. Water is common. But when you have CO_2 available, CO_2 works extremely well. It dissolves residual oil and improves recovery efficiency.

Originally, this had nothing to do with carbon sequestration. It was about making more oil. In the 1960s and 1970s, there was a lot of research on how to produce more oil. That unintentionally led to early carbon sequestration efforts. You know, once they figured out that you could inject CO_2 into these reservoirs to make more oil, the question arose: "How do you find the CO_2"?

Now, CO_2 does occur naturally in the ground. So, in the initial period, CO_2 was taken from the ground and then put it back into a different reservoir.

I was working on a project in Oklahoma, where waste CO_2 from a fertilizer plant was piped 115 miles to oil fields and injected underground. It was constructed in the late 1970s and cost hundreds of millions of dollars — which was enormous at the time. It was energy-security driven. Only later did we recognize its sequestration value.

Understanding energy systems: a primer

Srikanth: *Thank you for that nugget on unintended consequences. For readers who may not be in the energy industry, could you please explain the terms upstream, midstream, and downstream?*

Colin McCulley: Sure. So, the traditional kind of oil and gas energy industry is split into three components. Upstream is where the petroleum is produced. Wells, wellheads, pumping units, for instance.

Midstream is the connector. It's how you go from those wells to the processing where you can make a refined product. So, pipelines, trucking, railroad cars.

Downstream is where the crude product is refined into things that a consumer or business may want. Indeed, one of the byproducts of crude-oil production is natural gas, which is used to create hydrogen. That by itself is a billion-dollar industry — and we're trying to disrupt it.

Srikanth: *In the energy discourse, there is occasionally confusion between hydrogen being an energy source versus being an energy carrier.What's your perspective?*

Colin McCulley: That's a great question. Chemically, hydrogen is a very reactive molecule. The traditional hydrogen industry, as it exists today, produces hydrogen largely for its reactive properties. Of course, hydrogen itself can be combusted, but it's really just an energy carrier.

Vema's idea is to produce hydrogen from underground resources that naturally have that potential energy. So, we only take a few kilowatts of energy to produce one kilogram of hydrogen. And so instead of being an energy carrier, we kind of flip it on its head and we make it a primary energy source. It's a paradigm shift.

I'm not an energy historian, but some people say this is the first new primary energy source discovered in decades — maybe since geothermal or nuclear. That's what makes it exciting.

Srikanth: *That is indeed exciting. Now, there's a lot of talk about gray, blue, green, white, and orange hydrogen. How should one interpret these colors?*

Colin McCulley: Sure. The "hydrogen rainbow" is basically marketing shorthand for production methods and it goes in and out of fashion. Right now, it appears to be back!

The dominant methods of hydrogen production today are natural gas reforming processes — primarily steam methane reforming (SMR), and increasingly autothermal reforming (ATR). Both are pretty carbon-intensive. The product is referred to as gray hydrogen.

Companies then wanted to differentiate their products. So, they came up with blue hydrogen, which is the same as gray, but they add on some sequestration of the emissions — and that costs twice as much.

Green hydrogen is when they use renewable energy to split water to make hydrogen. This has lower emissions, of course.

Geologic hydrogen is hydrogen that comes from the earth. Only relatively recently did we understand how that could be commercialized. Engineered geologic hydrogen, or orange hydrogen, is when hydrogen is created from the earth using stimulation methods, like injecting fluids and catalysts, to accelerate hydrogen generation. If you're curious as to the choice of color, think of an iron fence exposed to the elements. It'll start to rust and it will turn orange.

Separate from that, white hydrogen is when the geologic hydrogen is in naturally occurring deposits, similar to a natural gas reservoir. There's been a lot of fundraising on it and there's been a lot of wells drilled.

In Vema's case, we work on engineered geologic hydrogen, the orange kind, using proprietary catalysts as well as heat to speed up what would otherwise be a slow chemical reaction. Our process has extremely low emissions — less than five kilowatt-hours per kilogram.

Now, iron is the most prevalent mineral or element within the earth. So, if we can oxidize that, we could be making more energy from that than from all known oil and gas reserves.

That's kind of the blue sky. That's why people are excited.

Respecting the environment, assessing risks

Srikanth: *That's fantastic, Colin, and a ray of hope for those of us thinking about climate risk. Talking about the energy transition, I understand that much of it is being built by people like yourself who started their careers in oil and gas?*

Colin McCulley: Yeah, absolutely. I think there's a lot of interesting overlap and synergy.

First of all: Working underground teaches you humility.

You're dealing with rock that is miles below the earth's surface. You can't see it. You can't touch it. You're operating with incomplete information.

> "Working underground teaches you humility. You learn to de-risk enough to move forward — not to eliminate all uncertainty."

There's a saying: the math doesn't math. You can model everything perfectly on paper, and then the rock tells you something different. You have to be able to think on your feet.

Oil and gas has over 100 years of experience managing that uncertainty. You learn to de-risk enough to move forward — not to eliminate all uncertainty. That mindset transfers directly to geologic hydrogen, geothermal, lithium brines — any subsurface energy system. At some point, you have to drill and see. You can't simulate forever.

Srikanth: *You've been speaking of subsurface environments. Do you put on a hard hat and enter a capsule that takes you underground and you go to work many kilometers beneath the earth's surface?*

Colin McCulley: No, unfortunately. There's no way to put a big enough hole in the ground to do that. So, you can't send anything sizeable down there. The industry is therefore focused on very, very narrow tools because putting holes in the ground is enormously expensive.

The holes are less than six inches in diameter. You can stick your hand in, but you can't possibly go down there. Everything that we're learning about the environment down below is from these rather specifically designed narrow tools that can be lowered into the ground either with pipe, with cable, or hydraulically.

I wish I could go down there and look at it.

But the remote sensing technology has improved dramatically just over the course of my career, using techniques originally developed for medical science. Some of the same tools that are used to image like the brain and the body are used now downhole to image the rock.

Redefining hydrogen: The Vema Hydrogen approach

Srikanth: *Excellent — it is instructive to be reminded of how technologies can jump across industries. Let's talk about Vema's core offering. How do you accelerate that natural, geological process in a controlled way?*

Colin McCulley: Vema's core product is engineered mineral hydrogen (EMH). Our method in general is to find rock that is most suitable to produce hydrogen. Towards that, we have geology and geochemistry departments that work on laboratory experiments to understand the hydrogen potential of certain types of rock. Once we understand the chemical reactivity of various rocks, we focus on the ones most suitable for our proprietary process. This involves injecting a fluid mixed with a catalyst into the rock. By the way, we use non-potable water. So, we are not competing with freshwater resources. Within hours or days, we start to see hydrogen formation.

We see Vema as an upstream hydrogen company. We want to make the hydrogen and then do what it takes to get it to market using partners who have technical expertise in the downstream side of things.

Since we spoke of midstream earlier: One of the big fundamental differences between hydrogen and other primary energy sources is that hydrogen is very difficult and expensive to move. That's because it is a very tiny molecule. Remember, it's number one on the periodic table. Ideally, people try not to move it. So, the existing hydrogen industry is largely co-located with natural gas.

Srikanth: *You've recently moved into field testing in Quebec. What does that transition from lab to field look like?*

Colin McCulley: Moving from a laboratory environment to field-scale is the major step in any technology's life. The pilot in Quebec is all about proving that the reaction goes the way we think it should, that the deposit that we're trying to exploit is behaving the way we expect in terms of rock mechanics and fluid mobility, and that we don't have anything unexpected.

Towards that, we need to align deep technical experts — geochemists, chemists, and theoretical chemists —

with engineering considerations. The whole team then also needs to engage with the regulators, the community, and future offtakers — companies that commit in advance to buy the hydrogen once production begins. We're really building the playbook on how this can work.

Quebec's been great to us. They have really, really good geology. The permitting and regulatory environment too is very supportive. The language barrier is real and the weather's cold, my goodness. But it's been great.

Community engagement

Srikanth: *Excellent. You mentioned "engaging with the community". What does that mean in practice?*

Colin McCulley: You know, you have to get social acceptance to be able to build infrastructure projects. Twenty-five years ago, this was nice to have — now it is critical.

So, we're really engaged with the local community in Quebec, talking with some of the leaders, working with local businesses, answering questions in the field for people who are worried about what our exploratory work could mean.

We make an effort to educate people about what we are doing — and try to demonstrate that this is something worth having in their area. As you know, this is a large economic development. A lot of the rocks that we're attracted to are in areas where there used to be a mining industry. And so, coming in and reactivating some of that infrastructure and bringing good jobs back to the area is typically very exciting for them. But it takes patient communication, and we recognize that responsibility.

What next?

Srikanth: *That's admirable, Colin. With that, the last question of this insightful conversation: What gets you excited about coming to work every day?*

Colin McCulley: I think the most exciting part about this is the blue-sky potential.

Engineered mineral hydrogen could become a multi-billion-ton global resource that competes directly with fossil fuels. It's clean. It's scalable. It's cost-competitive. That's exciting.

More personally, the energy transition is often talked about as this kind of nebulous idea. Like something that should happen. Something that we need to happen.

But I go to work and drill the first wells. I am making it happen.

> "The energy transition is often talked about as something that should happen. I go to work and drill the first wells. I am making it happen."

About The Giraffe's View

The Giraffe's View is a long-form leadership conversation series on technology, risk, and innovation, featuring investors, founders, academics, and corporate leaders.

Each conversation has been lightly edited for clarity and length.