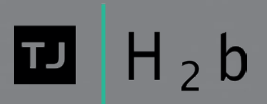
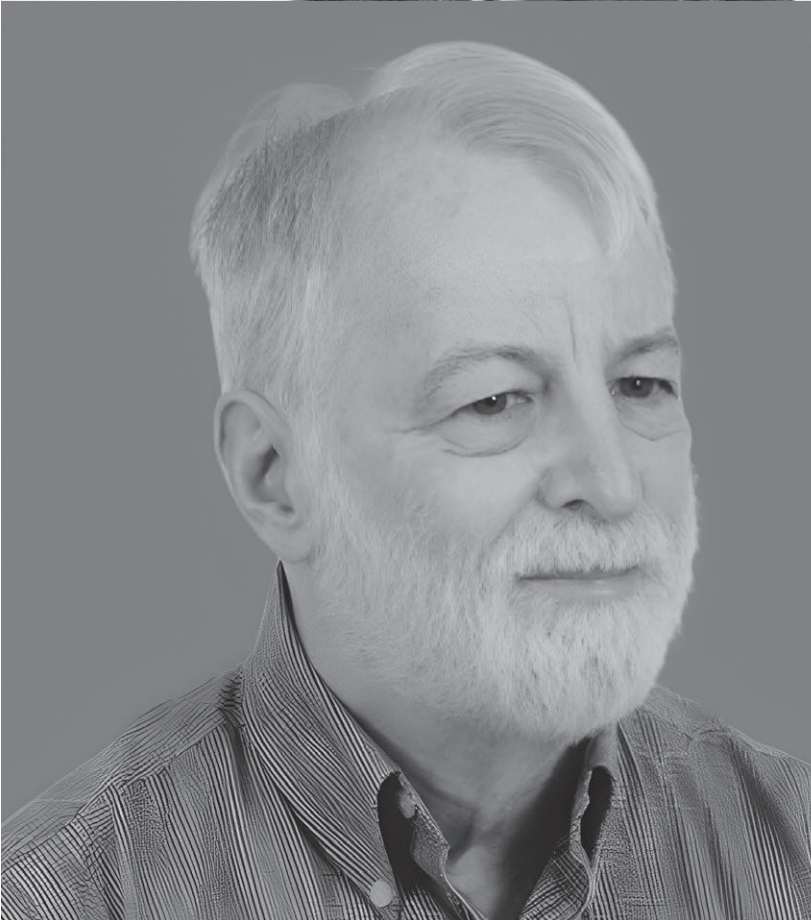


POWER PANEL DISCUSSIONS

Javiera McGuiggan
Assistant VP & Global Business Director, Cargill BioIndustrial



Claude Beauchemin
Director of Technical Development, TJIH2b



Insulation Systems - Oil, Fluids, Solids & Cooling Systems



Thomas Norby
Technical Manager - Lubricants and Electrical Industry, Nynas AB



Alan M Ross
Managing Editor, APC Media



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Javiera McGuiggan

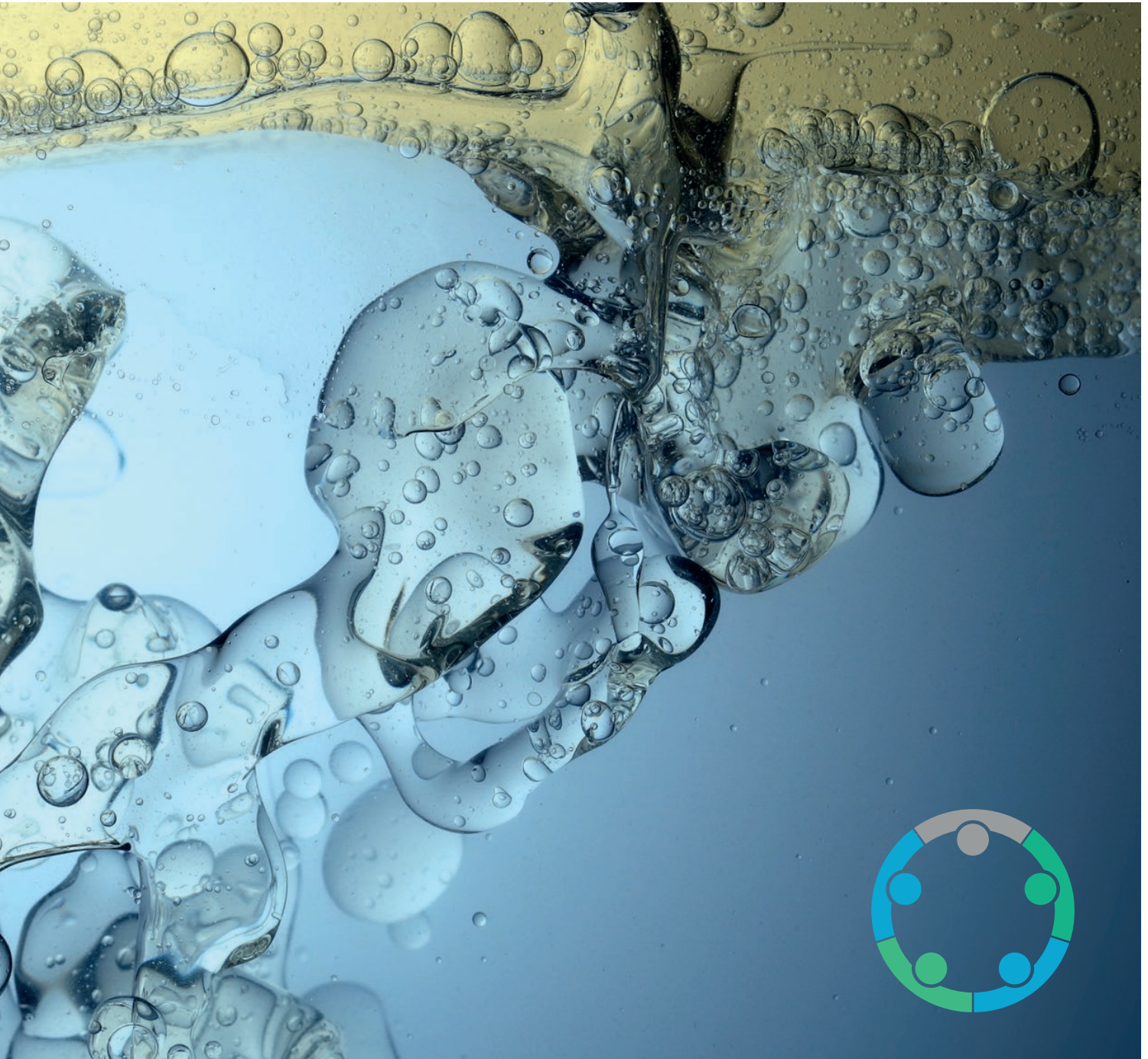
Alan Ross: I would like to thank our guests for joining us on this edition of our APC Media Power Panel, Javiera McGuiggan from Cargill Bioindustrial, Thomas Norrby from Nynas and Claude Beauchemin from TJH2B. Thank you all for being part of this. Before we get started, if you would just briefly tell us a little bit about yourself and your background. Thomas let's start with you.

Thomas Norrby: Thank you, Alan. I am an organic chemist by training, and I have worked in the lubricants and oil industry for about a quarter century. I work with Nynas for dielectric fluids for insulating for the electrical industry. I am active in IEC and CIGRE environments and I work closely with our key customers in the transformer OEM industries, and also with the

utilities. So, it's very nice to be here today and to share a few of our thoughts and experiences from the field.

AR Thank you, Thomas. Javi, I see your FR3 fluid logo behind you?

Javi McGuiggan: Yes, thank you, Alan. I am the Global Business Category and Assistant Vice President of Cargill Bioindustrial- Power Systems. I have been leading the power systems business with dielectric and cooling fluids within Cargill for over five years now. I originally am a Hydraulic Engineer who ended up in very technical but still business-related jobs for my career. I am the Commercial Leader, and I also have the technical team under me. We have the beautiful mission of turning some of our derived nature chemistries



from renewable resources into industrial applications. And of course, FR3 fluid is one of the star products of Cargill Bioindustrials.

AR Thank you, Javi. Claude, you are with TJH2B and one of my go-to people on lab testing for transformers.

Claude Beauchemin: Thank you, Alan. I am a chemist by training, but I have been involved with electrical engineering all my life, so I live between two worlds. I have been working for 45 years in transformer and transformer insulation materials. The first part of my career I was involved with online monitoring. I was part of a company that introduced online monitoring and transformer management, and I moved to TJH2B 14 or 15 years ago now. The bulk of my

job today is more on the interpretation side and the specification side, than on the analytical side proper. TJH2B also puts on the TechCon Conference every year, which I am part of.

AR Thank you, Claude. By the way, I think TechCon is one of the best technical conferences I attend every year because it is very utility-focused. It is a great conference, and I think it is in my hometown of Atlanta, Georgia this year, correct?

CB Correct. March 3-5, 2025.

AR Yes, I will see you there for sure. The first thing we want to do before we talk about oils and fluids, even though that is

our topic, is to get your perspective on where we are relative to transformers in Europe, UK, and North America. Let's start with you, Javi.

JM It is a unique time, with incredible accelerated growth and demand for the power industry that you would think was super-established and very traditional. No one is surprised by the growth anymore. We have been living through that since COVID. I think what we are all working on now is staying close to our strategic accounts and our OEM partners, to really understand market dynamics and how long this growth is going to last.

We just heard a study projecting 5X growth for transformers in the next five years. That is almost an absurd level of growth where we must get multiple resources in balance. Overall, our partners and customers say, "We knew the wave was going to happen, we just didn't know everything would happen at the same time", meaning aging grids, the expansion and creation of grids where you have newer population or growing or more developing countries, the electrification of everything from water heaters in California to, of course, vehicles.

Adding to this is the sustainability push, which in our case has been a key driver to explore different options and closely aligned with the renewable energy industry. So, we have seen

noticeable shifts from supply and demand being so unbalanced with more developing regions like China, India and Korea, moving into higher levels of penetration in markets like Europe and North America. Very smartly, those regions are investing in expanding capacity and expanding plants. It is not something that happens one day to the next, but hopefully gets us to a better and healthier balance between demand and supply.

AR Thank you, Javi, great insights. Thomas, your thoughts?

TN We share much of the same opinion. It is interesting to see mature industries suddenly being yanked from 2% to 5% yearly growth to multiples of that or even 5X, which is FinTech or IT type numbers. Of course, when you have to build hardware and actually have physical products, that is not going to happen rapidly. What we have seen, the European OEMs have invested wisely in production capacity in China, Vietnam, South Korea and India. Many of these units are coming back to Europe and even more so to North America. We also see the big local South Korean super brands like Hyundai. From our perspective we see a lot more interaction with many, many more OEMs and also huge orders driven by the things that Javi just mentioned. But I really want to underline the huge impact of renewable energy in large offshore wind



Photo: Shutterstock

installations such as we have around the North Sea. These are absolutely massive Apollo-type projects. It's like putting a man on the moon. They are completely rewriting the story about energy around the North Sea.

For example, in the North Sea, the traditional oil and gas industry is slowly shrinking and the move to offshore wind is absolutely massive and we believe it will be sustained, because it will take such a long time, decades. Yes, I believe there's been an inflection point, and I think that we will go as fast as we can for a long period of time because I don't see any reversal of electrification. Transformers will be snapped up as quickly as they can be produced. I think it's really a permanent shift of tempo, and we need to find a good, stable, standardized way to work, including the use of all the products; fluids, support software and everything else. So, it is a really important time for the industry, right? Can we deliver?

AR Thanks Thomas. Claude, you see it from a different perspective. You see it from the standpoint of the existing infrastructure and all of this new infrastructure. What are your thoughts about the transformer market?

CB Well, it certainly is an interesting time. Of course, my perspective is more

on the material going into a transformer than in their quantity. But even the increase in the quantity will challenge the laboratories around the world. We will have to add equipment and people. Equipment is easy, with people sometimes it is another story. I have to say that since I got into the industry 45 years ago, I've seen a lot of changes. It was effectively, initially, a very traditionalist industry. Nothing was moving. Everything was taking forever. At some point in time, we started to see some pickup in the pace of evolution development, and today it's really active. While we are talking about liquids today, the same thing is happening on the solid material side. One of the challenges that the analytical side has to address is the evolution of interpretation. We used to see information that meant something was good or bad, and now the interpretation has evolved as the material evolved. For example, for gas in oils, traditionally we focused primarily on hydrogen and acetylene.

Now we have new liquids, and the interpretation is a bit different, and we have to be careful. What used to be a level that created panic will now be normal with another liquid, and the reverse is true as well. There is an evolution taking place, like the push for vegetable oils is growing.

The amount of demand for energy is tremendous. Will it be satisfied?



There's been an inflection point, and I think that we will go as fast as we can for a long period of time because I don't see any reversal of electrification. Transformers will be snapped up as quickly as they can be produced. I think it's really a permanent shift of tempo, and we need to find a good, stable, standardized way to work, including the use of all the products; fluids, support software and everything else.

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Claude Beauchemin

That remains to be seen. One thing for sure is the demand on the equipment is increasing. Because the demand for transformers is increasing and the supply is restricted you need to keep existing units operating today for longer than expected. When I was new in the field I was talking about mineral oil because it was the only thing available at the time. When the mineral oil was degraded enough, the situation in those years was to replace it, send the used oil to the boiler rooms, burn it, and just put new oil in the transformer. It was disposable. It was acceptable then because it was inexpensive, but it is no longer acceptable today.

JM I love Claude's comments because he is such an expert in oil analysis. We, with natural esters, are still the new kid on the block, even though we have been in the industry for almost 30 years. We always use that quote from Einstein, "Everyone is a genius, but if you judge a fish by its capacity to climb a tree, it will live its entire life thinking it's a stupid animal." That is what we need to get over.

AR Einstein said that? That is funny. There is a learning process that the whole industry needs to do. Thomas, we will start with the following: Protect me. I am a transformer owner, and I cannot buy them fast enough to replace the old ones. How do I avoid an unplanned outage, and what should I be aware of?

TN The noble art of asset management is becoming even more important today. If I were responsible for asset management, I would make sure that I train and retain my

key staff so that I have people out there who know what they are doing. Taking care of the equipment as Claude said, interpreting the analytical data correctly to, let's say, turning every stone and realizing that the value of the systems which are up and running is actually probably greater than you think.

There was also some interesting news at the Paris CIGRE sessions this summer. One of the keynotes was from Professor Werle from the Institute of Electric Power Systems about some recent findings on how these renewable energy transformers are doing; what is happening with the type of generator. It is now so big, massive, with like a million new transformers in the field that the problems are starting to show up in the statistics. There are differences which are not so subtle when you have lots of harmonics and transients. While this has been known, we are now starting to see how it plays out in the field.

AR Claude, talk about this same thing, how do you help utility managers avoid unplanned outages?

CB The idea here is to try to detect early warning signs that may indicate that something is degrading and needs to be investigated. When we must replace a transformer, the main problem, today, is that the replacement transformer sitting on the pad "just in case" that used to be there is no longer there, because we have that pressure on supply and could not have made idle units anymore. The way to help is the same as in the past, but maybe we speak a little bit louder now; is to interpret the signs. Try to see if you can



extract from those signs given by analytical techniques or online monitoring of a possible issue, to see if this is rising fast or slowly, which is not obvious by any stretch of the imagination, and then educate the end users about its signification. As an example, we have methanol as a way of looking at paper degradation now, where we used to have only furan. It is a question of education. We have to be in the loop to educate and give tools to the operator to interpret what we see.

AR Javi, same question.

JM All I'm going to say pertains natural esters. In my campaign that states esters as a name, synthetics and naturals are very different animals themselves. Natural esters is what I am going to talk about. Thankfully, and this is one of the reasons why naturals have grown so rapidly lately, is that we provide a couple of technical reasons why you get almost a little insurance to prevent failures. The first thing is that, in the past, units that were aging needed to be replaced. If you had the availability of new transformers, you would have just replaced them. The oil change to FR3 fluid, the molecule of vegetable oil, in particular soy, is very long and it engages part of molecules that could be in the transformer from moisture or free water, trapping it. By trapping part of the water molecule, it keeps it away from the solid insulation. With solid insulation staying dry, you are effectively prolonging the life of a unit. Secondly, some utilities are using a new concept of dual rating in transformers, even though the standards are still in development. We already

have some utilities in the US utilizing this concept of having the same size of a nameplate unit, but knowing that because of the more than double flash or fire point in natural esters, you have this built-in risk that if you have a low load that's higher than what you had planned for, that is, you have plenty of capacity with that same unit. That is, again, much like a safety insurance thing. Or in the case of supply availability, you can buy one size of transformer that now can serve more than one function. Now you could use the same unit for multiple purposes until you can get more transformers. Again, it is a concept that is still working through IEEE, of dual rating nameplate to give you this access to a heavy load or unplanned peaks, is some of the things that we are seeing.

In Europe, it has a different name. The concept of using that higher temperature rise capacity goes more under something called SPL or sustainable peak load instead of dual nameplate rate. It refers more to building an efficient, smaller, more compact unit, so you get the advantage of using less of the other more expensive ingredients, components of a transformer, and making a smaller unit to get the same amount of power. These are some of the things that you can do with esters to address the crisis of supply and demand.

AR Let's discuss the impact of overheating on the paper, because the life of the transformer is the life of the paper. The oil protects the paper. The life of the transformer is the life of the paper. Talk a little bit about what you're seeing and the growth of the esters, natural and synthetic esters.

I am familiar with a lab that had a 1% annual growth with testing of esters, then it had a 1.5% annual growth until it had a 2%, just in the testing that they were doing. So that indicated the number of new ester-filled transformers in the market. Talk a little bit about what you're seeing as it relates to the oil, the fluids, and the paper.

JM As you know, we always talk about how conservative this industry is. I feel this topic of working with high temperature and high heat, either the dual nameplate or the sustainable peak load concept, is new. They're innovations in this world that have been a little more pushed and accelerated because of the super unbalanced demand and supply that we have. I think we will learn more and get maybe more comfortable as we learn more about these concepts, but they are newer. And there's a great study of our friend Fernando from the Copper Association, he always shares the analysis of the load losses, high load, low load and no-load losses. He has a whole paper and analysis that he presents at conferences. At the end of the day, we hopefully need to start looking at the overall benefits and limitations together, not just the limitations, because it's an innovation. It's a push for change, but we'll learn more.

AR Most retrofilling cases are required to be done on site. What are the key parameters that need to be checked to ensure that retrofilling on site would not be a risk for an unplanned outage?

TN First thing to be checked here is if you really need a retrofill. Check very carefully your business assumptions before any retrofill. Most of the times what we are seeing in practice, namely in power transformers throughout the backbone of the electrical grids (at all voltage levels), is that reclaiming the in-service fluid is more than sufficient to give the desired additional boosts to the technical lifetime of the liquid and of transformers. Minimum disruption is still an "innovative" approach for such a risk averse and critical activity/industry.

If a retrofill or oil change is deemed necessary, the requirements would be similar to other industrial lubricant systems. Ideally, you will have the time and opportunity to take a sample of the transformer oil that is in the unit. You can test it according to IEC 60422:2024 and make sure you understand what condition it is in. Then, do a miscibility study with whatever you are wanting to put into the transformer. Ideally, maybe you can get 95% of the old oil out, but the sludge will be impossible to get out.

You need to look at the range of blends, ideally, to see if 95% is good enough, if you're happy with the results you're looking at 95%. Usually, there's a sharp transition at some point when, let's say, the benefits of the new clean oil will dominate the problems and wipe them out.

Oil analysis and miscibility, unfortunately, is time consuming and costly. It is the only way of reducing the risk significantly. Then there are other very simple things like readings on the nameplate, finding someone who remembers what was actually in the system and having analytical tools to support your decisions.

There are a lot of good guidelines in the 60422:2024, and I'm sure there's the corresponding one with IEEE. Guidelines are there on how to do it. Read the instructions. Try to fill it up with an oil which is supposed to be compatible, that reduces the chances of nasty surprises for sure. But you have to read up on it and try to figure out the documentation or get testing if there is no documentation, right?

JM I would only add that the process itself to keep the process of retrofilling safe, the guidelines and recommendations, is pretty similar for both oils. There's a new particular standard on retrofills being worked on as we speak, for IEC in Europe, that is going to add better cautions or more detailed explanations for esters in particular. The process itself is not that different. In general, we always get a question of how much mineral oil is left and if it affects mixing it up with natural esters. And the question is, after the proper cleaning process, heating things up and cleaning them up properly, is there always going to be about 3% to 5% of mineral oil that's still in the system because that's what it was usually operating with before? That is perfectly normal, and it doesn't affect the function of the transformer later. But we have been very fortunate to have great partners in our retrofill channel in the US, and they have never reported a failure after a retrofill, so we're very happy to say that.

AR Javi, we are going to end with a look into the future. What does the future at Cargill Bioindustrials look like?

JM I believe that our mission of what we do in Cargill Bioindustrials is beautiful. I am very happy about all of the businesses that are trying to grow from nature. Renewably derived chemistries in the industrial world are having a great moment, which is a great thing for all of us. Overall, what we're doing is trying to keep pace; trying to keep up with the

speed of growth on top of the supply-demand imbalance that is in the dramatic, accelerated global growth in the industry, as we discussed earlier. We know how important it is for people, especially after COVID, to have that security of supply, the certainty that it is the same product everywhere, that it has the quality that it needs to have, no matter what plant it came from, because if one has to shut down, we will have the backup system to keep providing customers. So, we are working extensively on the expansion of our current plants. We have more than seven plants now and we are working on other expansion projects to be able to keep up with that growth.

But I think the most important message that I want to leave with is that this beautiful wave of growth of the energy. The world just needs us to do better and more for cleaner and better energy. There is also a push in this traditional industry to look into new things and to be forced to innovate. You have two paths. You could say, "Keep the status quo, I will stay with what I know." But the world is pushing you to look into these innovations like natural esters or high heat or whatever comes next.

We are also very focused on teaching everyone that not all esters are the same. There are going to be a lot of new players coming into the market, so how do you learn how to evaluate them and trust them and still keep your knowledge and education up to date on all the confusion that might come? That is what we're working on at the latest.

Finally, sustainability is another area we are working on, developing a transformer sustainability evaluation, not for just the fluid. Moving from just the fluid carbon footprint to what is the full transformer carbon footprint and answer how do we make it better.

AR Excellent, thank you Javi. Thomas, what does the future for Nynas look like?

TN We do not manufacture esters ourselves, since they are a completely different value chain. Nynas is supporting the sustainable transition across the industry for the specialty products that affect people's lives every day in electrification and road infrastructure. It is a very key product for society now and in the future. Our specialty is refining non-fuel molecules into high performance, long-lasting specialty products.

We operate across international markets with a strong focus on Europe because we are based here in Europe. We work with the customers to

create solutions and find new pathways forward to technical issues. With the transformer we have a long list of wish lists and customer asks. Keep lowering the carbon footprint in the production process. That is something that we are doing very actively with bio-based electricity and also green hydrogen very recently. It takes a big bite out of the carbon footprint. Also, we are working on scalable production to keep up with a very rapidly growing demand and to maintain the supply of our products which are readily recyclable. We hope to see some growth of re-refined products also in our application, although it is still very small. We want to keep it easy for the manufacturers and the owners or operators, keep the valuable and trusted fluid miscibility and material compatibility properties intact.

We are also working on new products with extended cooling properties and lower viscosity to provide better ability to handle load swings, harmonics, and increased voltage fluctuations with the low inertia grids of renewable energy, which is a rapidly rising issue, products that allow the same design principles and OEM practices to keep it simple and keep it scalable and keep it affordable so that this magnificent growth can materialize.

AR Claude, I am going to let you finish, what is going on at TJH2b?

CB We have our worldwide group of laboratories, and as I pointed out, it is a learning process with these newer materials, these new situations, and we will keep abreast of it. We keep studying, we keep learning, we keep interacting with our customers, trying to help the customer. In turn, the customers help us with new cases and new things to look at.

AR Thank you to all our guests on this Power Panel. You all bring such great insight into the industry.



**POWER
PANELS**

Editor's Comment:

Watch the full recording of the discussion at this link: [Power Panel Discussion - Insulation Systems, Oil & Fluids, and Cooling Systems.](#)