Umicore

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Corporate Speakers:

- Saskia Dheedene; Umicore; Head of Investor Relations
- An Steegen; Umicore; Chief Technology Officer
- Joakim Thøgersen; Umicore; SVP Fuel Cell and Stationary Catalysts
- Lothar Mussmann; Umicore; SVP New Business Incubation, Catalysis and Connectivity and IP

Participants:

- Alex Stewart; Barclays Bank PLC; Chemicals Analyst
- Charlie Webb; Morgan Stanley; Equity Analyst
- J.B. Rolland; BofA Securities; Associate
- Sebastian Bray; Joh. Berenberg, Gossler & Co. KG; Analyst
- Mutlu Gundogan; ABN AMRO Bank N.V.; Research Analyst
- Unidentified Participant; UBS; Analyst

PRESENTATION

Operator: Good day and thank you for standing by. Welcome to the Umicore's position in catalysts to support the green hydrogen economy conference call. (Operator Instructions).

I must advise you that this conference is being recorded today on Monday, the 26 of April, 2021. I would now like to hand the conference over to your first speaker today, Saskia Dheedene, Head of Investor Relations of Umicore.

Please go ahead.

Saskia Dheedene: Good morning, ladies and gentlemen, and I'd like to welcome you, and thank you for attending today's call on this short notice. So this morning, we issued a press release on our R&D collaboration with Anglo American on PGM based catalysts that will simplify hydrogen storage and use infused cell electric vehicles. We indeed clearly see strong traction in the hydrogen economy in general, and it brings attractive growth opportunities for Umicore.

So the purpose of today's call is to give context around Umicore's positioning in various hydrogen applications. It is, however, not the purpose to give you a full strategic update nor to dive into financials, so I'd be grateful if you could your questions on technology rather than on numbers.

So on today's call, as you heard, we first have a formal presentation by An Steegen, our Chief Technology Officer; and Joakim Thøgersen, SVP Fuel Cell and Stationary

Catalysts. This will be followed by a Q&A where Lothar Mussmann, SVP New Business Incubation, Catalysis and Connectivity and IP also joins us.

So let's kick off. An, the floor is yours.

An Steegen: Green Hydrogen has the potential to become the major energy carrier in the future. H_2 for transport in Fuel Cell cars and trucks has the advantage of Zero emission, fast refilling, and long operation range. It can be used as a buffer and storage medium for fluctuating solar and wind energy using elektrolysis. And green Hydrogen can be used for the decarbonisation of the industry with the production of alternative fuels and other products.

Fuel cells have come a long way. Where 20-30 years ago, it was not clear which fuel to use (Gasoline, Methanol or Hydrogen) and when Hydrogen became the fuel of choice, there was also the question how to store it (pressure, liquid at -253°, or chemical bound). Hydrogen with a pressure of 700 and 350 bar is now common and based on this hydrogen filling station were developed and installed. So after 30 years we see now more and more commercial fuel cell vehicles on the market.

Umicore has been part of this journey from the beginning. At Umicore we have been developing catalysts for fuel cells and electrolysers for over 30 years. We started in 1990 with the first developments of Platinum and Carbon Black Catalysts. As part of the PMG acquisition in 2003, Umicore also acquired PMG's fuel cell catalyst activity. Since 2014, the increasing market interest has led to an acceleration of our fuel cell catalyst development activities.

In 2018, we established our first mass production in Korea. And one year later, we commissioned a new green field plant in Korea to be able to follow the growing demand of our customers. In 2020 we launched a separate business unit Fuel Cells and Stationary Catalysts and moved the business unit's HQ to Suzhou, in view of Chinese market development. We continue to explore opportunities to expand our activities contributing to the green hydrogen economy. That's why today we announced a joint R&D program with Anglo American Platinum on Liquid Organic Hydrogen Carriers.

Historically, our fuel cell activities have a strong presence in Europe. In recent years we have been expanding our presence in Asia based on the growing customer demand. We also continue to invest in R&D to develop the next generation fuel cell catalysts. Our global footprint consists today of 4 R&D sites, 2 production facilities, a customer support center in Japan and then most recently the opening of our FCS business unit HQ in Suzhou, China, to support our customers in the growing Chinese market.

Umicore is preparing the ground for future growth in the green hydrogen economy. Besides our profitable business activity in fuel cell catalysts for transportation with a turnover of 40Meuro in 2020, we are also developing catalysts for Proton Exchange Membrane, or PEM, electrolysers, using our 30 year experience in catalyst material development. We are also participating in joint-development programs with our industrial and academic partners.

Global logistics and storage of renewable hydrogen is expected to be an important element of a future CO_2 – neutral energy system! Today's way of transporting and storing hydrogen is mainly based on liquid H_2 which has to be stored at a temperature of -253C or on using compressed hydrogen at 350-700 bar. At this moment Fuel cell vehicles are mainly powered using compressed hydrogen. Insufficient infrastructure and refueling networks for compressed hydrogen represent one of the main challenges for a more widespread use of hydrogen in the transportation industry. At Umicore we launched an incubation program that focuses on Liquid Organic Hydrogen Carriers as a way to transport and store Hydrogen. LOHC technologies offer an effective alternative solution by chemically bonding hydrogen to a stable liquid organic carrier, which eliminates the need for compression, enabling a more practical and cost efficient way to transport hydrogen compared to the existing ways of hydrogen fueling.
That's why this morning, Umicore and Anglo American Pt announced a R&D development collaboration to develop PGM based catalysts for liquid organic hydrogen carriers (LOHC) applications for fuel cell electric vehicles.

The transition to renewable energy sources and using green hydrogen as an energy carrier, requires a number of critical Platinum group metals. The resource availability of these metals for large scale implementation of hydrogen based technologies, will be crucially important, especially due to the highly concentrated geographical distribution and the lack of substitute materials. That's why at Umicore we invest in a continuous R&D effort to reduce the metal loading of the catalyst while optimizing the performance and durability. Together with our recycling group, we are developing flowsheet to close the material loop to recycle these valuable metals from production scrap and in the longer term from EoL fuel cells.

Now I hand over the word to Joakim, and he will give you an update regarding our fuel cell catalyst business.

Joakim Thøgersen: Thank you, An. So the first growth opportunity in the hydrogen economy that we will address in more detail today is catalyst for fuel cell applications in transportation. We see significant potential in heavy-duty vehicles and in large light-duty vehicles with long-range requirements. This can be SUVs, this can be pickup trucks, they can be MPVs. There is a lot of traction in this market today, and we see it as an attractive near-term growth potential for Umicore.

We can go to the next slide, please. So we see a near-term growth potential for Umicore in fuel cell catalysts for heavy-duty vehicles and long-range light-duty vehicles. And what is it that Umicore is offering? Umicore produces catalysts for the cathode and anode electrode of proton exchange membrane fuel cells, PEM fuel cells.

We supply catalysts to customers in the entire value chain across the entire value chain, ranging from automotive OEMs, system suppliers, spec producers and membrane electrode assembly manufacturers, MEA manufacturers. And at Umicore, we do have the capabilities to support our customers in their development of fuel cell technology.

We can support them on how to optimally use our catalysts in their systems, in the systems and in the MEAs. And what is a future system? Please look at the diagrams to your right. And here you see a schematic drawing of a fuel cell system. A fuel cell is a device where you transform chemical energy into power.

Pure hydrogen is fed to the anode where it's split into protons and electrons, and the electrons can be used as an external power source. The driving force for this reaction is the presence of an oxidant oxygen at the cathode and the protons will be transported to the Proton Exchange membrane, the PEM membrane. It reacts with oxygen and pure water

Please go to the next slide. So we see this near-term growth potential in fuel cell catalysts for heavy-duty vehicles and long-range light-duty vehicles. And the fuel cell technology is actually a perfect solution to cater long-range heavy-duty vehicles and buses, providing a strong propositive power. In light-duty vehicles, we do foresee a widespread use of battery technology for battery electrical vehicles, but we also see a potential for the use of fuel cell technology in long-range light-duty vehicles.

And the key fuel cell technology in automotive applications will be the Proton Exchange Membrane technology, the PEM technology. And the legislation is supported globally in Korea, in Japan, in China and Europe. And by 2030, we estimate a market size of 150 gigawatts in heavy-duty vehicles and light-duty vehicles with a significant part in both segments.

In terms of catalysts, this corresponds to 120 metric tons of catalyst. So we see a growth potential. And as the demand of our customers is increasing. We definitely plan to scale up our production capacity. And you can expect sometime in the near future that we will announce further capacity expansions.

Already today, we are a qualified supplier of more than 10 OEMs across the regions, this being car and truck OEMs as well as stack producers and system manufacturers. And among these leading fuel cell companies, our materials and catalysts are being considered as a benchmark and materials in the industry.

And this is all based on many, many years of the research and development. And say, we have research and development and production in both Germany and Korea. And we commissioned our first mass production plant in Korea by the end of 2019, which means that already today, we have tons of scale capacity.

We'll go to the next slide. At Umicore, we have numerous key customer cooperations with OEMs as well as system integrators, stack and MEA suppliers. And as I said, we are today already qualified supplier of more than 10 OEMs. In this slide, you see the ramp-up time line for already qualified business awards in terms of SOP.

SOP is an abbreviation for start of production. And as you can see in this diagram, the first programs were already initiated last year. This year and next year, we expect the initiation of further programs. And by 2024, we expect a second wave of programs we started. And on top of this already awarded business do have ongoing engagements for new platforms globally.

Please go to the next slide. Umicore is a supplier of Hyundai Motor Company for fuel cell catalysts. And Hyundai Motor Company is one of the first manufacturers to make hydrogen fuel cell vehicles commercially available. And together with the Umicore, Hyundai focused on advanced fuel cell technology in order to boost range performance and durability.

And in 2018, the NEXO passenger car was launched, and this is today is the only fuel cell SUV in the world with a 135-kilowatt powertrain and a range of 666 kilometers. Umicore and Hyundai Motor Companies cooperation with Umicore as a supplier and co-developer of pem fuel cell catalysts started already back in 2009.

And this has led to high-performance and highly durable future systems with Umicore catalysts. And based on this, Hyundai already to date sold more than 10,000 NEXO vehicles with almost 7,000 in 2020.

We'll go to the next slide. Today, we supply the current generations of our leading fuel cell catalyst technology. And in this slide, you see the road map to reduce PGM loading and make fuel cell applications more cost competitive. By 2023, we expect to launch a third-generation of catalysts; and by 2027, a fourth generation of catalyst.

And this is all done in order to enable our customers to reduce PGM content and to increase durability of the fuel cell systems. This is based on in-house research and development, but definitely also on an extensive external research network on fuel cells with key institutes in Europe, U.S. and Korea. You may call we do open innovation with external cooperations with best-in-class academia and research institutes.

Thank you. You can go to the next slide.

An Steegen: Thank you, Joakim. As I mentioned before, compressed hydrogen is mainly used to power fuel cell vehicles today. And unfortunately, there is insufficient infrastructure and the fueling networks for compressed hydrogen we presented today, and that's one of the main barriers for more wide produce of hydrogen in the transport industry.

Liquid organic hydrogen carrier technologies provide now an effective alternative solution by chemically bonding hydrogen to a stable liquid carrier. And as such, it can eliminate the need for compression and make it safer, more practical and more cost-efficient to transport hydrogen using existing conventional fuel networks.

Now how does a liquid organic hydrogen carrier work? This LOHC are typically organic composes that absorb and release hydrogen through chemical reactions. That's why the LOHC can store hydrogen.

So how you look at it is that hydrogen, preferably produced ~~to~~ using electrolysis from renewable energy sources is absorbed onto the liquid organic carrier using a hydrogenation catalyst. This can be done at the remote site. This liquid substance is then stored transported using regular transportation means under ambient temperature and pressure towards the fueling stations.

Transportation of hydrogen over long distances is in that way safer, more practical, more cost efficient. Fuel cell cars are then fueled with hydrogen-rich LOHC, using existing fueling infrastructure and short refueling times. To power on the fuel cell car and onboard hydrogen releases from the LOHC system using a dehydrogenation catalyst.

So it's clears that LOHC has the potential to offer a great advantage by building on the existing infrastructure for loan delivery and fueling. But there's still quite some R&D work to be done to optimize the catalyst for dehydrogenation. The current catalyst system requires high pressures and temperatures for the dehydrogenation process, which is not compatible with the operating window in a fuel cell vehicle, and does not match with requirements for onboard applications.

Our R&D program at Umicore focuses on the development of new catalysts to allow a lower pressure and temperature regime for the dehydrogenation step. This is a long-term early stage R&D program within Umicore, and Umicore collaborates here with academic and industrial partners. The announcement earlier today between Umicore and Anglo American Platinum is also part of this effort.

Hydrogen comes in many forms and from fossil fuel based gray hydrogen to renewable g based green hydrogen. But today, 95% of the hydrogen produced is gray. But it's only green hydrogen that's compatible with a sustainable and climate neutral use of energy. For the production of green hydrogen, different electrolyzer technologies exist and are currently under development.

There is an alkaline electrolysis and proton exchange membrane or PEM electrolysis, solid oxide electrolysis and anion exchange membrane electrolysis. All of them make use of metal based catalysts. Alkaline and PEM electrolysis are the most likely be dominant in the next years to come.

The cost of green hydrogen depends especially on the renewable electricity price, but also on the investment cost of the electrolysis and its operating hours. A rapid scale-up of the electrolysis deployment will take place in the next decade .And if the renewable electricity cost continues to come down to a competitive range, green hydrogen could start to compete with gray and blue hydrogen by 2030.

Electrolysis produces green hydrogen from water and renewable electricity. And electrolysis uses a thin film membrane to separate hydrogen and oxygen. PEM type electrolysis uses similar catalysts as used in fuel cells. Umicore has a long history developing those catalysts and we can derive the know-how from the work that's going on in our fuel cell catalyst development.

PEM hydrogen production has the advantage of a fast start-up and a good dynamic behavior. It has no corrosion and only needs simple maintenance, and it has a small footprint- compared to alkaline technologies. But on the other hand, the higher manufacturing cost and catalyst costs are the main factors to address in the development of future PEM hydrogen technology and catalysts.

It is expected that both technologies will coexist for the coming decade. The PEM electrolysis market is expected to grow towards an accumulated 90 gigawatts by 2030 with an estimated estimated PEM catalyst demand of 6 to 7 tons by 2030. At Umicore, we continue to invest in R&D to optimize catalysts, further improving the efficiency and durability while reducing the metal loading.

We have collaborations with the best-in-class research institutes to accelerate our fundamental research. We are active members in well-established hydrogen platforms and forums to stimulate the green hydrogen economy, together with other industrial players, with governments and with academia. The government plays a critical role in defining National Hydrogen strategies and setting the ambition level.

As key takeaways, we would like to leave you with the following messages. Sustainability and carbon neutrality are high on the agenda of many governments and of Umicore, it is the way forward. And it's part of the post-COVID recovery plans of government across the globe. COVID strengthened even more the need for a sustainable energy transition.

Umicore has a 30-year history in producing catalyst materials for fuel cell cars and electrolyzers. This is led to an attractive business growth for fuel cell catalysts for heavy-duty vehicles and long-range light duty vehicles. We are already a supplier to more than 10 car and truck OEMs, system integrators and membrane suppliers. We have a global presence with 4 R&D sites and 2 industrial production sites in Germany and Korea. And We recently moved our business unit head quarters to China. This way, we are well positioned to capture significant near-term growth in the fuel cell capital market. In the longer term, we continue to invest in the development of higher performance and cost efficient catalysts for fuel cell vehicles and electrolysis, and more recently, also for the development of catalysts for liquid organic hydrogen carriers, with the potential to optimize transport and storage of hydrogen and to simplify the fueling of fuel cell cars.

And with this, I would like to end the presentation. Thank you very much for your attention. And the operator will open the floor now for the Q&A session.

QUESTIONS AND ANSWERS

Operator: (Operator Instructions) Your first question comes from the line of Alex Stewart from Barclays.

Alex Stewart: It's really helpful to understand this Umicore business. So I appreciate that. Just to be clear, my understanding is that you generate hydrogen using electrolysis. You convert hydrogen through hydrogenation through a liquid organic carrier. You put the liquid organic carrier into the car, that dehydrogenate extracts the pure hydrogen, the hydrogen fuels the fuel cell, you're left then with a liquid -- an organic liquid, which needs to be disposed off. But I'm struggling to see what the logic of all of this is.

Because there's roughly 40% loss of energy in an electrolyzer unit. There's then loss of energy and cost in hydrogenation. There's a lot of energy and cost in dehydrogenation. And then you need to extract the organic carrier. So that's a lot of additional energy loss.

And if the sole purpose of this is to ease the logistics and transportation of liquid or pressurized hydrogen to refueling the stations, in principle, I see how that works, but 99% of the rest of the market is investing in the sort of the old technology, which is getting pure hydrogen to the hydrogen fuel cells.

Could you perhaps talk about why you think this is better than the strategy that almost everyone else is deploying, it'd be very helpful, particularly around this energy loss and the energy conversion and the cost of hydrogenation and dehydrogenation and what to do with the organic carrier?

An Steegen: Yes. Yes, thank you very much for the question. So basically, as we have said-already, hydrogen is mainly being stored as a compressed gas. That's the way that fuel cell vehicles today are being foreseen with the hydrogen fuel.

For- compressed gas, of course, there is a lot of work being done today to make safe hydrogen tanks and there are many efforts going into safe fuel cell vehicle design and packaging under high pressure. They use have-sensor arrays. For instance, the vehicles themselves have arrays of hydrogen sensors that sound alarms and seal valves and fuel lines in case of a hydrogen leakage. Additionally, the pressurized tanks that hold the hydrogen have been tested repeatedly and found to be safe in collisions.
The consequence is that the tank contributes quite significantly to the overall cost of fuel cell vehicle.

Also the installation of the infrastructure and refuelling networks for compressed hydrogen stations,~~,~~ are still under development and that takes time. The advantage of liquid organic hydrogen carriers is that first of all it can be chemically bound on a liquid carrier. It is a very stable chemical reaction with very minor hydrogen loss.

It's a liquid under ambient temperature and pressure conditions, which helps also to take less volume up in the car compared to a compressed hydrogen tank. Since it is a liquid, just like fossil fuel, ~~so~~ it can make use of the same infrastructure.

That said, LOHC is still in an early stage development. We still need to work on the catalyst for dehydrogenation to make it compatible with onboard dehydrogenation. Also the efficiency needs to improve. But nevertheless it has the potential to basically be a very efficient hydrogen carrier towards the future.

Lothar, do you want to add some comments to this question?

Lothar Mussmann: Yes. Maybe just a few comments, but you raised the main point of cost that is also linked to compressed hydrogen in a tank. So that definitely can be replaced by a normal tank, again, like for the fuel.

The infrastructure, you use the same kind of tanks, boats to actually carry the hydrogen from places with very cheap renewable energy sources to places where hydrogen is used. So you're actually solving also some of the disconnect and the transport cost for LOHC is definitely significantly lower actually by the principal than you would have for compressed hydrogen, for example, on these distances.

And there, you also would not have an infrastructure like pipeline. There's a lot of discussions, for example, in Northern Europe, where you use existing gas pipelines. Unfortunately, these type of pipelines do not exist, for example, in between Chile and Europe. And then you would use the boat. So I see LOHC as a carrier, hydrogen carrier here as a very cost-effective fit.

Alex Stewart: If I could just comment on that because liquid hydrogen carriers are very effective to transport hydrogen long distances. I think people accept that. What I'm struggling to understand is the establishment of a hydrogen infrastructure network, pipelines, liquefaction units, whatever it might be in order to power fuel cell vehicles is a huge fixed cost.

So in betting on another different technology, isn't that a little bit like trying to reinvent the wheel when the wheel is already mostly been invented because you don't have to double up the infrastructure to get the organic hosting carriers to the station.

You need to get the equipment in the space, you need to get the car companies to fit your catalyst and the additional units the tank. It just feels like the whole world has gone so far down the pure hydrogen for fuel cells that it may be difficult to get everyone to change to this technology. Perhaps I'm missing something because this is the first time I’ve heard about this…

An Steegen: Thank you again for your comments. I think what we are basically trying to accomplish here is the following, we want the fastest penetration of fuel cell vehicles in the market. And anything we can do to resolve the bottleneck of fueling and infrastructure and where we can help, we will do that.

We're not saying today that compressed hydrogen is going to be replaced by liquid organic hydrogen carriers. Likely, it will be an additional way to store and transport hydrogen. And if you look at the maturity of these technologies, compressed hydrogen is already being used today, while liquid organic hydrogen carriers ~~is~~ are still under development.

So we see LOHC not as a replacement for compressed hydrogen,. Liquid organic hydrogen carriers, the idea would be if you can develop it well, that you can reuse current fueling infrastructures overtime to transport the LOHC.

So in that case, it should be much cheaper to use the existing fueling infrastructure compared to a completely new infrastructure that needs to be set up or that is being set up for compressed hydrogen. But again we are not saying that one will replace the other. We are basically looking at all angles to solve this bottleneck of hydrogen transportation.

Lothar Mussmann: Maybe just to add here, the examples where this could idly apply. We also see it more on the bigger mobile application like trains, trucks and potentially marine and maybe big, big cars because you're right, you have to install this dehydrogenation step as a unit that takes some place, and you will most probably not put that on the smallest car.

But this being said, trucks, are very often operated on very remote areas, just go to a mine. And there, it would be very costly to install that type of infrastructure just for that mine. And here, actually, by easy carrying of this LOHC and using it directly, for example, on the trucks, makes it really efficient.

Operator: Your next question comes from the line of Charlie Webb from Morgan Stanley.

Charlie Webb: Maybe just 2 from me. So first, I think you've kind of been sharing how big the business is, I think, got EUR 40 million of sales, including the metals. I just want to check my understanding. That primarily today relates to the fuel cell business.

And then when we think about the fuel cell business, if I remember rightly, I mean, Hyundai has been obviously a very important collaborator and partner. Is it fair to say that much of that is associated to -- sorry, your business with Hyundai? Just trying to understand the kind of 10 other OEMs that you're qualified with versus the Hyundai partnership has obviously been somewhat longer standing. That's kind of the first question or questions, sorry.

And then second one, just around PGM loadings and thinking about this organic liquid hydrogen. Is there a significant difference in the PGM loadings when using this solution? Is that an attraction? And maybe you can just remind us today kind of where Umicore sits on PGM loadings for their fuel cell technology? How does that compare to the industry and the benchmark currently set, is that the benchmark currently set, would be very helpful.

An Steegen: Yes. Thank you for the question. So I think the first question was regarding the fuel cell business and the revenue that we generated. I would like to remind you that, this call is mainly to talk about our strategic activities and the application domains that Umicore is developing in the green hydrogen economy space.

But that said, we see definitely the fuel cell market and demand picking up. So that contributes largely to our profitable business that we have today. For the second part of the question, Joakim, I don't know if you want to clarify a little bit the numbers that you have already put up there in your presentation?

Joakim Thøgersen: Yes, sure. I can do this. And the second part of the question was on the number of customers and Hyundai being a dominating customer. Today, actually, we have multiple customers in the future business.

And it's not only -- it's not a regional dive. As we present in our presentation, we are qualified at more than 10 OEMs, and we have multiple customers already today. And to the first part, I mean, I confirm that at the EUR 40 million turnover related to the fuel cell business.

Charlie Webb: Sorry, so just to clarify, Hyundai isn't kind of a major customer as it isn't a dominating customer, you have a broader mix now and that relationship be diluted by the broader mix.

Joakim Thøgersen: We have a broader mix.
Charlie Webb: Okay. Understood.

An Steegen: And maybe to add on to the question, we are- today also capable of supporting the demand in electrolyzer catalysts. This market is still growing and it's still picking up. And you've seen the numbers that we showed, 6 to 7 tons catalyst by 2030, that's the estimated forecast today. So today, we are well capable of supplying the smaller amounts of electrolyte catalysts to our customer base.

Charlie Webb: Sorry, maybe on the second question, I wasn't clear. Just trying to understand the difference. When we think about the organic liquid hydrogen technology that you're investigating and pursuing. Is there difference in PGM loadings between the catalyst used in that process versus the traditional gasified pure hydrogen?

An Steegen: Yes. So first of all, again, liquid organic hydrogen carrier, that program is an early stage R&D program. So the catalyst development work, that is what we are working on right now. It's too early to say how that development is going to evolve over the coming years. But clearly, this is a different mechanism and a different catalytic system. We will use our catalyst know-how and expertise here in-house at Umicore to develop ~~that~~ the catalyst for liquid organic hydrogen carriers. This development work is early stage–and has a roadmap for a couple of years ahead of us.

Operator: Your next question comes from the line of J.B. Rolland from Bank of America.

J.B. Rolland: Sorry, can you hear me now?

An Steegen: Yes, we can hear you.

J.B. Rolland: Apologies for the delay. I just wanted to ask you 2 questions. The first one is in relation to the capital intensity of developing fuel cell catalysts and also other types of hydrogen catalysts.

Since we're -- this is an activity which is related to PGM, could you give us an idea about how capital-intensive this activity is compared, for example, to cathode materials? And whether you would expect or we should expect that mass market development would require you to raise capital if your balance sheet couldn't sustain net debt-to-EBITDA leverage?

And then the second question is related to barriers to entry. From what I understand, it looks like you have an early mover advantage given the number of qualification with OEMs that you already have at this stage. And I'm wondering beyond the early mover advantage, whether you feel that bears to entry, technological barriers to entry are at a different level versus battery material.

An Steegen: Yes. Thank you for the question. About your first question on capital intensity, we will not talk about financials today in this call. But clearly, as we've mentioned before, we see that the market opportunity is growing for our fuel cell catalysts and later on also for the electrolyzer catalysts. So there are definitely opportunities for Umicore to continue to grow our business in this domain.

Then regarding barriers to entry, you're correct. I think at Umicore, we have- a couple of advantages. We have 3 decades, almost 30 years of experience in catalyst developments. We have, from the beginning, very strong and early engagements with a broad range of partners across the entire ecosystem in the fuel cell space.

That helps us- to early on already co-design our material into their systems, which gives usat this moment an advantage, and that is also know- how that we've been building up over the last years.

And also, our sustainable metal supply and metal sourcing, is, of course, also an advantage for Umicore and a potential barrier for others to come in.

Lothar Mussmann: And if I may, maybe just add something, Jean, this to the capital-intense so today, of course, it's too early to tell. But what we can confirm is that it's not at all comparable with the existing mass production scale of the cattle business.

J.B. Rolland: Can I just squeeze another quick question in relation to your qualification with OEM. Can you give me -- can you give some granularity about maybe not the names, of course, but just an idea about over how -- which period of time you have built this portfolio of customers, please?

An Steegen: Joakim, do you want to take this question?

Joakim Thøgersen: Yes, sure. I can take this question. This is not customer relations that you build overnight. This is a result of long-term cooperations with global OEM. This being said, we also see a lot of traction in the market at the moment. And it's clear that such cooperations have accelerated over the last couple of years, with all the attention on the hydrogen economy.

And to give a comment to the entry barriers in the field. People, people working with fuel cell catalysts, they will know that this is, in fact, a quite complicated catalyst system. And they will know that it takes a long time to develop optimal solutions in this area, and the entry barrier is not small.

Operator: (Operator Instructions) Your next question comes from the line of Sebastian Bray from Berenberg.

Sebastian Bray: I would have 3 questions, please. The first is on the sales figure of EUR 40 million. Could you give us an idea of the step down in sales that would occur if you were to exclude the metals component is about EUR 30 million, excluding metals, a reasonable guess? My second question is on end market application.

Proton-exchange technology has several applications in stationary storage or especially power generation at a low level. Why is this not a market that Umicore has targeted? And my third question is on the catalyst loading for electrolyzer technologies versus fuel cells. Why is the tonnage of catalyst required to make 1 gigawatt of electrolyzer so much lower than the amount required 1 gigawatt of fuel cell?

An Steegen: So if I heard you correctly, there are 3 questions. The first question was regarding the EUR 40 million sales and the metal breakdown. So today, we will not comment on any breakdown on the revenue and also not on the metal revenue.

I think your second question was about the end market applications. And if I understood you well, you asked why ~~10~~ electrolyzers are not used for storage,?

Sebastian Bray: My question was more -- so there are some applications of PEM for smaller stationary, stationary power generation. Why is this not a market Umicore is targeting?

An Steegen: But it is-- just to be clear, our focus is catalyst development for the PEM electrolyzer market. Today, if you look at the 2 most mature electrolyzer technologies that are out there, one is alkaline, the other one is PEM electrolyzers.

They have, of course, different advantages and disadvantages, where PEM has the advantage that it has indeed a smaller footprint, ŧ To address intermittent energy from renewable sources, that is typically where a PEM electrolyzer is utilized because of its compactness and also its dynamic behavior. So we are definitely working with our catalyst activity towards this application domain.

And maybe also, as I mentioned before, Platinum group metals areused for PEM electrolyzers. There, we can benefit from our know-how in our fuel cell catalyst development work. While metal -- catalyst metals used for alkaline or non precious metals levels today. So again, we clearly cover this application space with our PEM electrolyzer catalysts.

And then the third question regarding utility loading. The loading depends on the environmental conditions and the harsh conditions under which this electrolyzer or fuel cell operates.

And typically, when you look at a fuel cell car, the harsh environment there requires your catalysts can do the work of activating, selecting the right materials for the catalytic reaction, and ensuring that the durability is good.

So that typically makes that the loading of fuel cell catalysts is higher than that of electrolyzers. But I'm sure that also Joakim and Lothar can comment on that last question, if they want to.

Joakim Thøgersen: Yes. I can start. It's Joakim here. First of all, for fuel cell applications, especially in automotive applications in order to reach the power density requirements and the durabilities, the industry average today corresponds to catalyst loadings in the range from 0.8 to 1 gram per kilowatt with the platinum loadings in the range from 0.2 to 0.3 grams per kilowatt. And this will give you the power density and the durability required in automotive applications.

Lothar Mussmann: And just for me to add. And if you compare that now for electrolyzer, as An was stating, it's operated in a completely different regime. You can imagine if you drive a car, on the highway and you do this acceleration, in this deceleration, you have a lot of fuel starvation, how we call it.

And that is actually causing a lot of stress for the material of a fuel cell. And this year, you counteract with the tendency of higher -- high loading to actually protect against these kinds of events in terms of durability. And that's -- we also talk about dynamics on electrolyzer, but here we talk completely different type of dynamic of being wind a little bit harder or less hard, and we are not talking about events like on a mobile application, that's the reason.

Sebastian Bray: Just first a point of clarification. My first question -- sorry, my second question on the stationary power generation applications is more referring to fuel cells. Is

Umicore involved in stationary power generation applications with its proton-exchange fuel cell as opposed to electrolyzer technology? And if not, why has it chosen to focus exclusively on the market for mobility?

An Steegen: We are not limiting the application space today. Our catalyst development work that we are doing, it is also suitable for stationary fuel cells. So we will definitely look into that. And I think Joakim is very well positioned to comment on that.

Joakim Thøgersen: Yes, indeed. No, we do not exclude the stationary power area. The design of the fuel cells and the catalysts are also here a little bit different from mobile applications, but you certainly target both applications.

Operator: Your next question comes from the line of Mutlu Gundogan from ABN AMRO.

Mutlu Gundogan: Yes, two questions. The first one is on the estimated market size of 150 gigawatt in 2030 for your mobile opportunity. I was wondering if you could split that between HCV and LDV?

And also, what kind of market share have you assumed in LDV? The second question is on PGM content, on the loading. Can you tell us what your assumptions are in terms of PGM loading, i.e., which metals will you use most? And how does it compare to your current PGM loadings in your existing mobile emission catalyst business?

An Steegen: So Joakim, do you want to take those 2 questions? First, the market size of 150 gigawatt?

Joakim Thøgersen: Yes. Here, we -- today, I don't really want to give a specific split between heavy-duty and light-duty applications. Also because this is early stage at the moment. What we can say is that we expect a significant portion of both segments in this business, this is what we can say today.

An Steegen: maybe to add -- so when you see all the ambitions of governments and announcements from major OEMs globally, that is, of course, the indication of a rapid growing fuel cell business in the coming years as well in -- especially in HDV, but also in long-range LDV, just to add to Joakim's comments.

And then the second one is on loading.

Joakim Thøgersen: Yes. And as I said before, today, in mobile applications, the industry average is 0.2, 0.3 grams of platinum per kilowatt as a loading.

An Steegen: What we can say today, in our development program we see how we can optimize the performance and the durability of the fuel cell catalysts while decreasing the metal loading and in such a way, come to more cost-efficient solutions. That's definitely part of the development program, but we cannot comment in more detail today.

Operator: And your next question comes from the line of Andrew Stack from UBS.

Unidentified Participant: It's a question about the market structure in catalyst area. You note that you have 10 customers already, and you say within OEMs and also the system providers. Just wondering if you could let us know what the balance is between the OEM and the system provider? So I'm assuming companies such as Ballard and Plug Power.

And a broader question, staying with the same team. If you take a 10-year view, how do you see this market looking in terms of who gets to call the specifications? So in other words, if you're selling a catalyst in this market, do you think, ultimately, the OEM puts the spec into its engine and dictates that sale? Or do you think it's the fuel cell system provider such as Ballard?

An Steegen: So what I can say to answer both questions is that, we collaborate early on with many players across the entire value chain, that can be membrane providers, stack providers, system providers. And this way, we basically work together early-on to integrate the catalyst in the system and- we do that for multiple fuel cell platforms. This way we can optimize our catalyst early on in the system.

And your second question Can you repeat your second question?

Andrew Stack: Yes. Maybe it wasn't the clearest. If you take the battery material business you have. One of the debates, I think the investment community has is it's who is putting the battery technology on the car. Is it the cell provider?
Or is it the cathode company, who's calling the shots and what goes on the platform. So it's the same question really for fuel cell components. Do you think it would be Ballard who would, in the end, spec, the platform for the OEM? Or do you think you'll directly relay that to the OEM?

An Steegen: well, it's too early. The value chain is still developing. So it's too early to say how the ecosystem will evolve. Today, we work with all players in the ecosystem, including also car OEMs to understand system specifications and that we do all the time. But it's too early to say how the value chain in the end will develop.

Operator: Now I would like to hand the call back to the speakers for some closing comments. Thank you.

Saskia Dheedene: I'm afraid we'll have to close here. So I just wanted before we end this call today to repeat as a strategic focus is for us clearly on clean mobility, where you can develop a really an close collaboration with the OEMs that I just wanted to clarify as there were some comments or questions around stationary applications as well.

So thank you for attending today's call. If you have any remaining questions, please don't hesitate to get in touch with Investor Relations. Have a nice day. Bye-bye.