ERT

Innovation made in Europe

Setting the foundation for future competitiveness

"If I had asked the public what they wanted, they would have said a faster horse."

Henry Ford, Founder of Ford Motor Company

"Innovation distinguishes between a leader and a follower"

Steve Jobs, Entrepreneur

"Innovate, or be history!"

Dr Sara Mazur, Scientist

"If I have a thousand ideas and only one turns out to be good, I am satisfied."

Alfred Nobel, Chemist, Engineer & Inventor

"If at first the idea is not absurd, then there is no hope for it."

Albert Einstein, Mathematician

"Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity."

General George Patton

"The present is theirs; the future, for which I really worked, is mine."

Nikola Tesla, Inventor

"The value of an idea lies in the using of it."

Thomas Edison, Inventor

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."

Marie Curie, Physicist, Chemist & Radioactive Science pioneer

Introduction

Dr Martin Brudermüller
CEO of BASF SE and Chair of ERT's Committee on Competitiveness & Innovation

Dr Lars Frølund
Deep Tech expert at MIT and Member of the Board of Directors of the European Innovation Council

Ludwigshafen in January, on the BASF Werksgelände, a mid-sized town of its own with a 158-year history of innovation in the chemicals sector.

We met to record an episode of ERT's podcast *21st Century Industrialists*. The guests are Dr Lars Frølund and Dr Martin Brudermüller. The topic is 'Innovation made in Europe'.

It is a fascinating conversation, and there is no better opener to this ERT Flagship Paper.

We start with a basic question: **How has their career shaped their view on innovation?** With Lars, it was an early fascination on how we as human beings and as organisations can accept the "crazy" things that push the boundaries and that "we have to appreciate to really move the world forward". Martin was nurtured in scientific curiosity from childhood and studied chemistry, but when he joined BASF (in 1988), he realised that "it is good to have an idea and to be academic, but at the very end, it is about making money and bringing prosperity to people".

How do they feel about innovation – and especially European innovation today? Both are very candid, even emotional. Martin points to his own experience in China (2006–2015) and recalls the dynamism with which China has built its innovation and scale-up capabilities. Looking at Europe, his "heart is bleeding to see that we have given up that leading position" and he is driven by the question of how we can bring back this "innovation spirit and hunger to try new things". Lars was struck by the "different type of mental bandwidth" he experienced at MIT – and "the courage to have ambition" – which for him was an eye-opener.

Circling in on the European situation, what stands out? Both Martin and Lars agree – Europe is still strong in general basic research and scientific leadership – as Martin puts it, "here the European community has probably done its best job". But we are "coming down to mediocrity when it comes to getting innovations to the market". And Lars adds that "there are still too many companies that have the right potential to get into the market, but when they actually want to grow, they suddenly move to the US and become a Delaware company".

So why is that? Lars sees a main issue in Europe's lack of the right vehicles to enable start-ups to grow – Europe has a lot of wealth, but "we don't have the right [risk] capital". For Martin, the main factors holding back companies are the European way of "regulating everything" and that we do not use our Single Market in a way that allows faster scale-up and "generates the revenues to stay in the game".

What can Europe do to ramp up innovation?

One answer is to facilitate collaboration. Lars puts forward the idea of an "internal market for research infrastructure" to provide start-ups with access to advanced laboratories of both research institutions and corporations. Martin agrees and emphasises that even a company like BASF would "not survive with its own research only – it is all about collaboration … and cooperation is the art of innovation looking forward." He is concerned, though, that Europeans are still "too egoistic" to leverage the power of collaboration. Lars points to another challenge: "getting from a start-up's idea to impact" – i.e. how to get start-ups "to work with some of Europe's large corporations that have infrastructure and production capacity".

Another proposal is to create markets for innovation. For Lars it is important to set strong demand signals where you "stop buying the cheapest thing and start buying the best thing" – with a procurement system that does not predefine the solution already, but defines the problem – so that start-ups can develop solutions that find a market.

But is there a pre-condition for Europe's re-bound on innovation? For Martin, it is obvious that Europe has to "innovate regulation". This is a huge challenge as "in Europe, we want to regulate everything in detail. We generate a regulatory framework to enforce the transformation" of our industry. But it does not have to be like this. The US – most recently with the Inflation Reduction Act – "generate a business case to facilitate transformation". Europe could also learn how to regulate markets in a way that new products can flourish. But for now we seem to be stuck with an approach to regulating everything in detail although it is "holding back the whole ecosystem" – start-ups, academia and even big companies like BASF.

Is Europe capable of that? Maybe – both are a bit more hesitant. Martin points out that during the COVID-19 pandemic when European companies developed vaccines at record speed, we managed to break that pattern – "everyone asked 'what is my contribution to make it happen?'. We need to make this the normal spirit in Europe".

Why is an innovation re-bound so important? Both agree that innovation underpins that, if Europe's economic competitiveness. And that if we lose competitiveness, we will enter a downward spiral. As Martin puts it: "if you are struggling to be competitive, you also start saving on innovation and research. So that comes all together". Or you shift innovation and production abroad because "Europe is not the best place anymore". And that is why, when we "talk here about R&D, we have to talk about the overall competitiveness of Europe."

For Lars, bringing deep tech innovation to the market also means building production – and therefore new employment. Nurturing and scaling up deep tech innovation is therefore "a way to also create a sounder welfare state and better societies". Martin agrees – we are increasingly living in a high-cost environment – and we are more and more in need of a high share of very productive high margin business. This is "crucial for the survival of Europe and our level of wealth" because if we "only stay with the old products, we don't have the space to finance all the social ambitions we have as a society". And as Lars brings it to the point, today "innovation matters in a totally different way for societies".

Is Europe experiencing a catharsis moment? We could have reached that point. Martin in any case hopes so – because since the Lisbon process, we are aiming but "failing to become the world's most innovative region". And it is "almost programmed that we will fail again in the future if we don't focus" and if we don't "question many things that may have been right in the past, but that will do not do the job going forward".

Lars feels cautiously optimistic as "people talk again" about the "levers which you need to keep the industrial base of Europe competitive". To be in "more economically difficult times is a healthy part of a long-term societal development". We are at that point – and Lars does not "give the race lost … but a lot of painful things have to be done".

If we had to bring it down to one message – what would it be? For Martin, our choice is to "innovate or be history[1]". Lars brings it down to "stop competing not to lose but start competing to win. And if we can get that mentality going then we are there."

In our podcast Lars and Martin touch on many more aspects of innovation, spanning from pirate ships to innovation theatres to the nature of deep tech to pension funds.

We won't give away more, but we urge you to listen to the episode and hope you'll enjoy the ride.

ert.eu/podcast

1 Quoting Swedish physicist Sara Mazur

Contents

Executive Summary

Rarely before has innovation been so important.

Europe's competitiveness has been on a downslide for quite a while. The reasons are largely home-made[1]. Now additional pressures arise from renewed geopolitical uncertainty, the energy market implications of Russia's war in Ukraine and the attraction of business to the US as a result of the US Inflation Reduction Act.

ERT has mapped Europe's global industrial competitiveness and made policy suggestions in our latest Benchmarking Report. This flagship paper sets out ERT Members' views on where Europe can and has to do better to remain an innovative powerhouse, a leading industrial base and a prosperous continent.

Our paper contributes five core observations and three priority policy messages. We have also collected 34 Innovation Stories as told by our Members – ten are included in this report, and all can be accessed on our website[2].

Five observations on Europe's status-quo in innovation

First, compared to our global peers and competitors, Europe's investment in R&D is relatively low. With a few exceptions, we are far behind in the tech race in the ICT area, and this endangers Europe's position in the next industrial revolution (i.e. Industry 4.0). An underlying cause is that in Europe's regulatory system, transformation is steered by regulation, rather than encouraged by incentives and business opportunities.

Second, with tools such as Horizon Europe and IPCEIs, Europe has a very elaborate innovation support system in place. It still has significant untapped potential which can be realised by scaling up scope and funding, and improving efficiency and impact. Simplification of bureaucracy and easier access to funding and common projects would be key.

Third, in the European R&D mix experimental development – which is 'high-risk, high-return' – plays a much smaller role than for other innovation leaders, such as Israel, South Korea, the US – and also China.

Fourth, our global peers and competitors take a strategic approach to creating synergies that stimulate innovation. This includes programmes enabling civilian and military research cooperation or specially designed ecosystems for product development.

Fifth, innovation increasingly builds on collaboration – whether cross-sectoral or between different types and sizes of companies. This makes triggering innovation even more complex. It also implies that current and future innovation support systems need to cater for a very diverse and interlinked ecosystem.

Three priority policy messages to help unleash Innovation made in Europe

1. **Rethink** regulation. Europe can only be a frontrunner in innovation if EU decision makers put the business case for innovating and investing in Europe at the core of EU regulation.

   This requires a regulatory framework that is coherent with political goals and that is kept up to date to accommodate innovation timely enough for quick commercialisation. A coherent framework also includes fast approval processes and the facilitation of testing under real-life conditions. Moreover, we need a more pragmatic approach to IPCEIs – and have to foster private sector funding for R&D, which would be supported by an overhaul of the taxonomy rules and the fast completion of the Capital Markets Union.

2. **Re-focus** on robust Intellectual Property rights and international standardisation. Solid globally competitive intellectual property (IP) rights are key for the business case of innovation.

   Stepping up on international standardisation is important to avoid delays in innovation and commercialisation. It is also the only way in which Europe can preserve its role and values in global standards. This will be key for the digital and green transition and to avoid

1 See ERT Benchmarking Report 2022 https://ert.eu/2022BMR/

2 ERT Innovation microsite https://ert.eu/innovation/

delays and disadvantages in innovation and commercialisation.

3. **Realise** the scale-up of investment-intensive innovation. To move forward with the green and digital transition, we have to de-risk technology development. We can do so through public-private partnerships and innovation oriented public funding.

Europe's response to the US Inflation Reduction Act

As this paper is being finalised, the European Commission has just published its Green Deal Industrial Plan. This could be a huge opportunity to improve the EU's innovation support system and competitiveness – provided it is crisp, pragmatic and effective to facilitate economic investments in the EU.

Specifically on the innovation process, the Commission delivers a promise to support innovation through faster permitting and better testing conditions for selected sectors. We urge the EU to broaden this promise to all sectors and industries and make sure that the promise becomes reality by immediately tackling the issues addressed by this Flagship paper.

Additional policy messages targeted at specific challenges can be accessed on the ERT Website.

Scan to explore all ERT Innovation stories

I. Innovation made in Europe: still going strong?

For a long time, innovation made in Europe has been the driver for our economic success – domestically and in terms of exports and direct investment abroad. And yet, our innovation leadership and industrial competitiveness cannot be taken for granted.

Global competition is increasingly fierce across industrial sectors – and also increasingly complex. The bigger picture includes factors such as Industry 4.0, the green transition, geopolitical trends, supply of raw materials and energy prices.

Technological change is fast paced, and on a global market, breakthrough innovation, wherever it takes place, has a global impact. Technological leadership is always challenged, and any failure to keep up is punished fast by customers and markets.

1) Global innovation leaders: where does Europe stand?

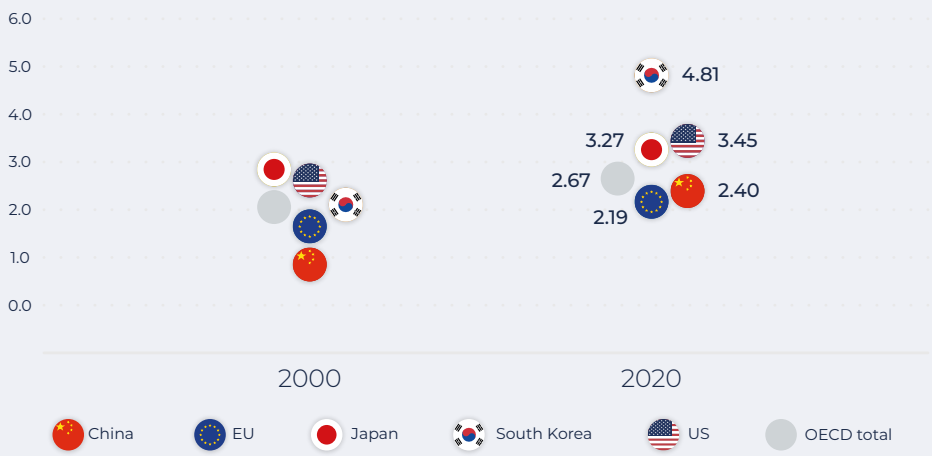
R&D intensity

In 2021 the EU's average R&D intensity was estimated at 2.27% GDP[3], far below its long-held ambition to invest an annual 3% of GDP into R&D (a target originally set in 2000 for 2010).

As OECD data on R&D intensity show, the EU is clearly lagging behind global peers (see Fig 1 for 2020 data).

Within Europe, R&D intensity varies strongly across Member States. Sweden is leading with 3.35%, followed by Austria (3.22%) and Belgium (3.19%) – which also rank highly in global comparison. On the other extreme are Slovakia, Cyprus, Bulgaria, Latvia, Malta and Romania – all with ratios below 1% of GDP.

Figure 1 - R&D spending as a share of GDP, %



Source OECD. For a full evolution, see the ERT Benchmarking Report 2022

The EU is challenged not only in terms of average R&D intensity, but also structurally as innovative regions and inactive regions are likely to drift further apart in terms of competitiveness and sustainable economic development.

A shift in corporate R&D investment

The December 2022 EU Industrial R&D Investment Scoreboard[4] found that in 2021 the global top 2500 companies' R&D investment surpassed for the first time EUR 1 trillion. Of this investment 40.2% was made by 822 US companies and 17.9% by 678 Chinese companies who have for the first time overtaken the 361 remaining European corporations (17.6%).

The number of Chinese companies, many of which in the ICT sector, has tripled since 2012 – displacing more traditional manufacturers from Japan and the EU. On the other hand, the average European (or Japanese) company (still) spends significantly more on R&D than the average Chinese company (but less than the average US-based company).

The Scoreboard findings reflect a global tech race that is intensifying in four key sectors:

ICT products and services attract the highest R&D investment, and the race is largely between US and Chinese companies.

The health industry tech race is predominantly between US and EU companies, and marked by much higher R&D investment in the US.

3 Eurostat, November 2022, EU investment to R&D increased to EUR 328 billion in 2021 https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20221129-1

4 Accessible here: https://iri.jrc.ec.europa.eu/sites/default/files/contentype/scoreboard/2022-12/EU%20RD%20Scoreboard%202022%20FINAL%20online_0.pdf

In the automotive tech race, European companies are leading in R&D investment, but spending by competitors in the US and China is growing much faster. High R&D levels can be explained to some extent by the green transition.

That said, Europe has a very diversified industrial base. Many 'traditional' European industries are comparatively mature, and those sectors might not attract extremely high levels of R&D spending in any jurisdiction. However, also in those more traditional sectors European R&D investment does not always come out on top.

Human capital and patents

Europe is a hotbed for scientific research. EU, UK, Switzerland and Norway together are home to 2.3 million scientific researchers, the highest number globally. China, however, is catching up fast and has already surpassed the EU-27[5].

And yet, Europe struggles in turning this advantage into business opportunities, and notably patents. Patents are a key indicator of an innovation system's current competitiveness, but also allow some prediction on the future competitiveness of an economy versus its peers: patents indicate who will own tomorrow's key technologies.

The ERT Benchmarking Report 2022 shows that, compared to global competitors, Europe has fallen far behind in terms of patent applications in some key sectors such as ICT (with some exceptions, such as connectivity or biotechnology).

According to OECD data, climate change mitigation is the only area where Europe is a clear leader in terms of patents, but even here China is catching up fast. Also the US Inflation Reduction Act could well trigger a shift in favour of the US in the mid-to long term.

Observations

Europe's relatively low investment in R&D raises concerns for our industries' future competitiveness. These concerns are confirmed by trends in patenting applications.

In part the difference in R&D spending reflects the geographical concentration of the high growth ICT sectors in the US and increasingly China. But the reasons likely run deeper – the European policy/ regulatory environment is not best suited to create a business case for disruptive innovation. This is set out in more detail in our policy recommendations (Chapter III).

Looking ahead, Europe's lack of leadership in the ICT sector endangers our industrial base just as we are entering the age of Industry 4.0[6].

KEY INSIGHT: The relatively low level of Europe's R&D investment raises concerns for future competitiveness. We need to urgently restore the business case for innovation made in Europe.

5 ERT 2022 Benchmarking Report, based on OECD data

6 See ERT Benchmarking Report 2022 https://ert.eu/2022BMR/

2) Europe's support system for innovation: up to its potential?

European policymakers are keenly aware of the continuous innovation challenge, and over the last 40 years the European Institutions have put in place an extensive system to support research excellence and innovation made in Europe, and to enable synergies across the Union.

Europe's innovation potential clearly benefits from Horizon Europe (with its EUR 95.5 billion budget) including a new pillar (Pillar III) dedicated to supporting start-ups and scale-ups. The new approach to use Missions and moonshot projects to trigger innovation and innovation spill-overs across sectors is also promising. The New Innovation Agenda seeks to empower deep tech innovation and improve cohesion between regions.

The advancement of Important Projects of Common European Interest (IPCEIs) via EU support and State aid is a tool with high potential to scale up break-through innovations that under current regulatory and market conditions do not (yet) have a business case.

Since 2020 the European Innovation Fund has been created, supporting the development of low carbon technologies, and the European Defence Fund, set up to promote state-of-the-art and interoperable defence technology and equipment.

Separately, the European Investment Bank and national government agencies also take active part in R&I investment, with the provision of loan guarantees, direct funding or co-financing projects under EU initiatives.

In short, EU institutions are doing a lot to strengthen innovation made in Europe. Without these initiatives our competitive position would certainly be much worse. And yet...

Observations

There is room and need to make Europe's innovation support system even better.

The race for technological leadership is accelerating and geopolitical polarisation is making our world ever more complex and challenging. Europe's institutions need to ensure that we make the most of the system we have already in place.

First, it is key to improve companies' access to what is currently a fairly granular and process-heavy system.

Horizon Europe could better live up to potential if calls for applications are simplified to not deter potential participants[7].

IPCEIs, too, would become a more powerful tool, if the very lengthy and complex application and decision processes could be improved in an impactful way. The current realities of the IPCEI approval process do not adequately match the pace of market innovation and competitiveness objectives.

The Commission – with its Green Deal Industrial Plan – has announced that it will provide a code of good practices for the design of IPCEIs to speed up assessments and ease access for IPCEI-related projects by SMEs. However, this alone will not be enough to unleash the potential of IPCEIs. We also need greater pragmatism (on clawbacks, funding gaps, extensions, etc.), better synchronisation across participating Member States, and more transparent processes overall.

Second, we should think innovation support through to the end. Horizon Europe highlights excellent research and innovations but still struggles to bring them to market. As a result important innovations may not be realised (or at least not in Europe).

For some sectors, the new or enhanced Connecting Europe Facility and Digital Europe Programme should help to bridge that gap to market launch. But as long as Horizon Europe is not extended to the deployment phase, we are still lacking a general solution.

Third, let us be more ambitious learners from other innovation leaders.

KEY INSIGHTS: To make the most of the tools in place, we need to simplify access to increase participation, speed up approval processes and extend support to enable deployment.

7 Calls for applications trigger fierce competition between consortia to be selected, which requires strong investment from applicants (resources, time, costs, etc) that may not be possible for all types of potential interested entities.

3) Strategic elements of success: what to learn from other global innovation leaders?

To further strengthen the EU R&D support system and toolbox we should learn from those countries that are global innovation leaders.

What are the key factors for innovation success amongst our competitors? Europe should evaluate successful strategies elsewhere and see what should be incorporated into our system or which alternative policy action could have similar impact.

Figure 2 compares investment according to the different R&D categories for China, Japan, Israel, South Korea and the US with data for the EU.

One finding sticks out. In the EU the share of experimental development in total R&D spending is by far the lowest. Experimental research has a high risk to fail – but gives a real chance to discover the unexpected.

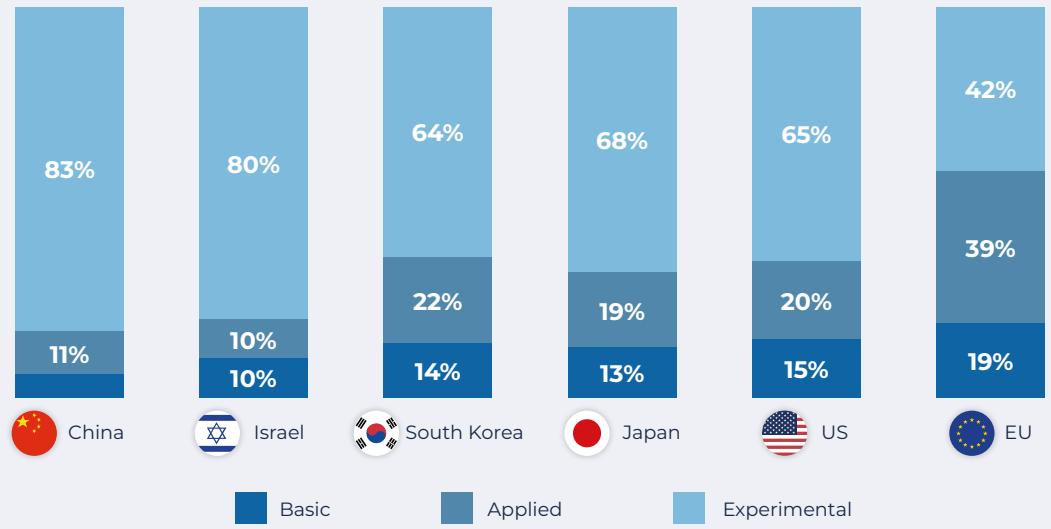
The US approach

In the US, many innovative activities are fostered by the Department of Defence through the Defence Advanced Research Projects Agency (DARPA). While DARPA's primary responsibility is to develop emerging technologies for military use, it also works closely with the private sector on innovations for civilian use. The internet, weather satellites and even Moderna's COVID-19 vaccine were created in part because of expertise and financing provided by DARPA.

The Inflation Reduction Act (IRA, August 2022) – although not undisputed in the US domestic debate due to taxation aspects – is expected to boost green innovation made in the US (both R&D and scale-up) by creating markets for domestically produced green energy solutions and domestically sourced components such as batteries, solar and wind components and carbon capture technologies. It provides for attractive tax credits for R&D, including for smaller enterprises.

From a European perspective, the IRA creates enormous level playing field concerns as the approach taken by the IRA encourages green technology scale-up by the creation of markets, enabling regulation and tax incentives to generate competitive costs as compared to existing technologies. The IRA also includes discriminatory elements that put European companies in a disadvantageous position.

Figure 2 - Comparison on R&D by business, government, education and non-profit by type of R&D (as % total R&D expenditure)



Source: OECD, data for 2020 and 2019
Notes: Data incomplete for Israel (government financed applied R&D) and China (non-profit financed R&D).
For EU-22, non-profit financed R&D missing for Bulgaria, Croatia, Cyprus, Malta and Romania.
Education funded R&D missing for Finland and Sweden, incomplete for the Netherlands.

China & South Korea

China and South Korea have created effective innovation ecosystems that facilitate rapid product development and commercialisation.

China has focused on developing a network of demonstration zones, often geographically tied to innovation and manufacturing hubs. Although China's large and relatively closed market is a key reason why corporates have managed to scale up production quickly, they would not have

managed to bring as many products to market without effective test beds.

South Korea's government is similarly providing enabling infrastructure – through business-friendly regulation and 'tech clusters' – that have accelerated product commercialisation and allowed large corporates to effectively collaborate with SMEs and start-ups. Such idea-sharing has proven highly effective in spurring innovation.

Israel

Israel takes a similar approach to the US with civil-military fusion innovation. For example, corporates used military data storage expertise to invent the USB flash drive.

Academia also plays a key role in the Israeli innovation ecosystem because of its connection to industry and focus on commercialisation. Not only do universities collaborate with – big and small – corporations, but they also excel at establishing companies themselves to commercialise innovations.

Observations

In comparison to other innovation leaders, Europeans tend to make less use of experimental development. Why is not clear. In part this could be down to risk aversion, availability of financing or lack of a clear business case for innovation – which in Europe may hold back more uncertain investment.

Our competitors link up research-intensive industries for better synergies. And they build structures that speed up product development and commercialisation.

Whilst US policymakers create a business case for innovation to facilitate transformation, the EU policy mindset seems stuck on the notion that transformation has to be enforced through a comprehensive regulatory approach rather than enabled by opportunity.

KEY INSIGHTS: Stepping up on experimental development could accelerate Europe's innovation scene, also considering Europe's lower R&D intensity overall. And, as showcased by other innovation leaders, synergies, speed and pragmatic frameworks for realisation and scale-up are key.

To free up Europe's potential, the EU has to incentivise and enable innovation instead of relying on reinforcement via regulation.

II. The corporate experience: collaboration at the heart of successful innovation

Large companies play a crucial role in the innovation process and their respective innovation ecosystems. It is well understood that their financial firepower and in-house R&D capabilities are important innovation drivers and enablers.

Yet successful innovation is increasingly the result of intense collaboration by a wide range of actors with complementary insights and abilities. The way in which large corporates interact and collaborate with SMEs, co-innnovators or key stakeholders evolves according to the maturity of the innovation.

Technology development runs through nine different stages – also defined as technology readiness levels (TRL)[8] – starting with the incubation of an idea to its commercialisation. The whole process can be structured into research phase, development phase and (pre-) commercialisation phase. The role of companies in these three phases is quite different and so are the challenges and requirements. See Figure 3 for an illustration.

Initial research phase

In the initial research phase (TRLs 1 through 3), large corporates are often the initiators of an R&D project – be it because of a mission set by top management, customer or government demands, or a company's strategic or sustainability agenda. Large corporates can also be the incubators of innovation through investments in in-house research and the setting up of research facilities.

When research is not done exclusively in-house, corporates provide research institutes and academia not only with private capital investments, but moreover share best practices and technical expertise.

Depending on the sector, R&D initiation can also take the form of collaboration with start-ups, SMEs, suppliers, customers, as well as other corporates. Such collaboration can range from co-design and co-development of innovation ideas and projects to setting up of business partnerships, sharing lab facilities and capacity building.

Technology development phase

In the technology development phase, TRL stages 4 to 7, large corporates drive Research & Innovation through business cooperation and capacity building. In addition to supporting start-ups and SMEs with capital investments and expert advice, large corporates also offer a built-in innovation culture of collaboration and knowledge sharing.

Finally, to speed up the process of going from idea to product, large companies play a role as co-innovators, for example in the establishment of innovation testbeds. TRL 7 also sees large investments, including when participating in public-private partnerships and major project consortia such as Important Projects of Common European Interest (IPCEIs).

Pre-commercialisation phase

In the final TRL stages – the pre-commercialisation phase – a large corporats' experience in the entire product lifecycle management process is a key advantage, from design and testing through manufacturing to the preparation for bringing a technology/ product to market. Start-ups and SMEs can draw on corporates to enable cost-efficient product manufacturing as well as on large-scale manufacturing organisations.

Corporates would also often initiate major market analyses to test a product's fitness for the market and to discover further use cases. In addition, large corporates play a key role in the development of commercialisation strategies that fit the specific characteristics of distinct regional markets.

KEY INSIGHTS: Collaboration between different stakeholders is becoming an increasingly important enabler for innovation.

Large corporates are often the ones to trigger collaboration projects. They partner with and enable research communities, start-ups, and SMEs in the development of new ideas, and are crucial in pulling in value chain participants and involving public authorities.

To be effective, innovation support systems need to cater for a very diverse and interlinked ecosystem.

See the ERT Innovation Microsite ert.eu/innovation for concrete examples of best practices and the full collection of ERT Member companies' Innovation Stories

8 TRL stages as defined by the European Commission in the Horizon 2020 programme as a means of measuring the maturity of an innovation project or technology.

Figure 3

Collaboration during Innovation: The role of large corporates

From idea/lab to mass market

Technology Readiness Levels reflect technology maturity

1	2	3	4	5	6	7	8	9
Basic principles observed	Technology concept formulated	Experimental proof of concept	Technology validated in laboratory environment	Technology validated in relevant environment	Technology demonstrated in relevant environment	System prototype demonstration in an operational environment	System complete and qualified	Actual system proven in operational environment

Research / applied research phase

Large corporates collaborate with...

Start-Ups	Private capital, corporate VC funds, expert advice, know-how, capacity building, business cooperation, equipment
SMEs	Co-innovation, business cooperation/ partnership, best practices sharing, private capital, new opportunities, know-how
Complementary Corporates	Business partnership, best-practices sharing, know-how, co-innovation
Research infrastructures*	Financial and human capital, shared labs/ equipment, industrial expertise, corporate VC funds, cost-sharing
Academia	R&D collaboration stipends, project co-sponsorship, knowledge sharing incl. on new industrial requirements or areas of interest
Employees	Company's entrepreneurship programmes, pro-innovation mindset, design thinking / agility, internal organisation
Suppliers	Co-innovation, collaboration, product specifications or design/material needs
Customers	Co-design and co-develop products that correspond to users' needs
EU and Member States**	Private capital, business cooperation, co-innovation

Technology development and demonstration phase

Large corporates collaborate with...

Start-Ups	Private capital, corporate VC funds, expert advice, capacity building, business cooperation, real data to test equipment, products...
SMEs	Private capital, know-how, business cooperation, real data to test equipment/ facilities/ new technology
Other large corporates***	Cooperation, best practice sharing, co-innovation, cost-sharing
Business incubators and accelerators	Private capital, know-how, corpoarate VC funds, technical expertise
Innovation test beds/hubs	Business cooperation, co-innovation
Customers	Collaboration, co-development
Suppliers	Enhancing value chain, collaboration, cross-sectoral solutions for new business lines, real data for tests of technologies, facilities
Sector regulatory bodies	Best-practices sharing, know-how, alerting on regularity barriers, participation in sandboxes
Public-private partnerships (PPPs)	Co-financing, joint de-risking technologies, in-kind support
EU and Member States**	Private capital, business partnership, best-practices sharing, know-how

Product pre-commercialisation phase

Large corporates collaborate with...

Start-Ups	Business cooperation, business relationship product-market fit, cost-sharing introduction to new business opportunities
Scale-ups	Private capital, know-how, product lifecycle management
SMEs	Business cooperation, business relationship, cost-sharing
Other large corporates***	Cooperation, best practice sharing, cost-sharing
Customers	Market analysis, testing of new products and services
Suppliers	Product manufacturing and deployment
Sector regulatory bodies	Alerting on regulatory barriers that impede scale-up of innovation
Standardisation bodies	Technology licensing & standardisation
EU and Member States**	Co-financing, technical expertise

* labs, parks & centers **institutions & agencies ***complementary & non-competing

III. Policy Messages: Corporate priorities to make a better business case for 'Innovation made in Europe'

Europe's corporates play a key role in driving and enabling innovation in our economy. And innovation is key to Europe's industrial growth and international competitiveness.

The corporate sector has a responsibility towards society in supplying progress, employment, and prosperity.

At the same time politics and society have a responsibility to provide the best possible framework for launching and implementing innovation efficiently and with impact.

In the following, we set out three priority recommendations to create a better environment for 'Innovation made in Europe'.

Additional recommendations can be found on our Innovation Microsite – ert.eu/innovation

Scan to explore all ERT Innovation stories

1) Rethink regulation

Political goals and supporting policy frameworks must create a pull for investment in innovation.

Europe can only be a frontrunner in innovation if EU decision-makers put the business case for innovating and investing in Europe at the centre of EU regulation.

Coherence and incentives are key. Long-term strategic priorities have to incentivise and reward innovation from a business perspective.

Incentives are key because they provide a business case for innovation that goes beyond mere compliance with requirements. Well-tailored incentives generate a much greater drive for innovation that also improves competitiveness more broadly and allow for greater creativity. Regulatory incentives moreover de-risk innovation investment and therefore free up resources for more R&D and faster deployment.

Coherence is key because incoherent regulation discourages investment and R&D in new innovative solutions. Without coherence, regulation is unpredictable or even self-contradictory – this creates uncertainty and increases the financial risk of investing and engaging in R&D activities for all actors along the innovation chain. Successful innovation builds on the collaboration of many stakeholders and organising this collaboration is itself already a considerable challenge: protracted uncertainty on whether, when and where an innovation can be commercialised can further discourage key stakeholders from investing their resources even into otherwise promising innovation projects.

Follow-through is essential. To achieve real coherence, political goals are not enough. It is nearly as important that sectoral and product legislation are aligned to foster the same goals and are free of contradiction and silo-thinking. Here the European Commission has an important role to play, but Europe's co-legislators also need to exert great discipline during the adoption process.

Keep regulation up to date. Political coherence is an empty shell without the determination to dynamically adapt and update product and services regulation to keep track of technical innovation. Here, too, silo-thinking can be a barrier to adaptation. Moreover, solutions are needed to overcome rigidity or lack of speed at the policymaking or policy adaptation level.

Why is this so important? If, due to outdated or inflexible product legislation, innovation cannot be brought to the market in Europe, it will not benefit our economy. Instead, it will strengthen the competitiveness of our peers and/or rivals who can then easily outrun European companies in the commercialisation phase.

Moreover, if companies need to price in the cost of time lost due to unfit regulation, they will adapt – whether by investing less in innovation, tailoring innovation to more promising markets or reducing the level of ambition to what can be commercialised under current rules. Each scenario means lost opportunities for Europe.

These concerns weigh heavily – and especially so in highly regulated markets and for the development of new materials. EU and national legislators should systematically build in mechanisms for time-efficient and timely updates when designing product regulation.

Speeding-up approval processes for new products/substances is key for instance for food contact materials, cosmetics, biocides or pesticides where consumer and environmental safety are of paramount importance. This tends to be the responsibility of national authorities – who often do not internalise that overly drawn-out processes spanning over many years present a significant handicap to innovation: they prolong uncertainty for commercialisation in often highly competitive markets and lead to losses in IP. Strengthening the business case for innovation would therefore also imply greater ambition in speeding up approval processes.

Europe's lawmakers and regulators must walk the talk when it comes to testing. Testing is as a key step in innovation, but we are miles away from a state where testing under real-life conditions is the rule, not the exception.

Innovation builds on lessons from trial and error. Everyone accepts that testing is key in the innovation process, but still there is little readiness to actually allow it under real-life conditions (provided of course the risks involved are limited and understood). Europe needs a change of mindset and to embrace openness to testing as a logical (even desirable) part of its innovative identity.

Europe could and should improve the conditions for testing new innovations:

- more comprehensive rollout of **regulatory sandboxes across all industries, including at European level**. Some Member States have understood this – for example Spain is planning to roll out sandboxes for AI innovation.
- **increased and fast funding for test beds** would also help speed up the innovation process by facilitating concept testing and adaptation to lessons learnt and customer needs. This proved effective in the product development phase for 5G.

Improving the industry's ability to test innovation would benefit all parts of the innovation ecosystem and not only speed up innovation but also increase the readiness to launch new projects as well as the appetite for collaboration between industry and academia. We hope the Commission's forthcoming Guidance on Regulatory Sandboxes can unlock potential across industries.

Walking the talk also means that instruments that have been put in place need to be made usable. Let us look at IPCEIs.

Fast funding processes are key. Public funding can be very important, but processes are often too slow. An extreme example are the approval processes for IPCEIs. By definition, IPCEIs are of a strategic interest to Europe, but too much valuable time is lost in administrative decision making. The fact that eight years into the creation of IPCEIs, only four have been approved speaks for itself. For the IPCEI approach to provide effective solutions to Europe's strategic challenges, approval processes need to be accelerated.

More generally, when designing or re-designing approval processes, greater speed is essential. Delays increase uncertainty, opportunity costs and the risk of being overtaken by rivals in more dynamic jurisdictions.

Foster private sector investment in R&D and start-ups. For private sector funding to support innovation going forward, the EU taxonomy can play a major role. If Europe is serious about its commitment to innovation and the twin digital and green transition, the taxonomy has to be adjusted to foster investment in R&D driving transformation. As it currently stands, the taxonomy includes bottlenecks that hamper investments in (activities that are prerequisite for) economic activities and technologies widely regarded as necessary for a successful twin transition. Especially innovation and best practices further up the supply chain are not duly recognised because of onerous technical screening or 'do no significant harm' criteria. The taxonomy can and should be adjusted to facilitate investments consistent with the EU's long-term strategic objectives. For this European policymakers would need to commit to coherent rules, allowing themselves a strategic long-term view and overcoming silo-thinking.

The long-discussed EU Capital Markets Union has huge potential to raise private capital for innovation but remains elusive for now. One point where greater coherence of EU policy would be key is to enable institutional investors, including corporate pension funds, to directly or indirectly invest in innovation-related activities, for example in start-ups. This overarching interest of the European economy should be reflected in financial services regulation, which at the moment seems to lack a greater vision. To initiate this, the ball lies in the court of the European Commission, but support by Member States and the European Parliament would be essential, too.

2) Re-focus on robust intellectual property rights and international standardisation

Solid and globally competitive intellectual property rights are key for the business case of innovation.

Investments in innovation are costly in terms of financial and personnel resources. Innovation processes can result in success or failure and imply taking risks and exploring the unknown. At the beginning of this process – which depending on the sector can span over years, even decades – there is no guarantee that the investment will pay off eventually by commercialisation to market.

Without soundly protected and efficiently enforceable intellectual property (IP) rights, there is even less predictability on commercialisation and pay-off is even more at risk. The reason is that competitors will find it attractive to copy new products, as this is easier and cheaper than a fully-fledged R&D project and shortens time to market. In short, for innovation to have a business case, sound and well-functioning IP protection and enforcement are key.

European companies need a solid IP system. This is important in all highly competitive sectors: Where development time for new products is long (such as the pharmaceutical sector), where the IP landscape is dense and competitive (e.g. renewable energy, new decarbonised molecules or CO2 storage in the energy sector) or where copying of products is comparatively easy (e.g. in software-related areas).

Effective IP protection also enables collaboration and technology sharing – indeed this has been the key success factor in the development of cellular technologies and underpins the global success of EU actors in this area.

The European Unitary Patent System, about to be implemented, is a model that looks promising, but still has to demonstrate its effectiveness and competitiveness in terms of the costs for applicants. One weakness is that so far not all EU Member States have joined.

In some sectors it will nevertheless be necessary to maintain strong complementary IP protection. For example in the pharmaceutical sector, Regulatory Data Protection remains key for clinical data generated during clinical trials and Supplementary Protection Certificates compensate for an early expiration of patents due to compulsory lengthy testing and clinical trials before commercialisation.

Leverage the existing IP system for digital innovation. Europe needs to build on its existing strong and competitive IP system with its special relevance to the digital industries. This is crucial for Europe's ability to develop next-generation technologies (such as artificial intelligence, the Internet of Things, data) as well as for digital economic development.

A joint challenge in moving forward is finding the right balance between a) the European Patent Office's guidance towards patent examiners regarding the protection of next-generation technologies and b) the related case-law based decision making. Why is this important? Protecting next-generation technologies is key to help strengthen Europe's competitive position – and for this we also need to provide greater clarity and certainty for innovators.

Step up on international standardisation. Beyond the EU's borders, policymakers need to address issues of complexity and geopolitical bias in international standardisation processes to avoid delays in innovation and product commercialisation.

EU Member States and the European Commission should support European industry in standardisation efforts. This can be done by ensuring framework conditions that provide incentives for technology contributions to standardization and promote a widespread adoption of the resulting standards.

A balanced and transparent licensing system for standard essential patents based on Fair, Reasonable and Non-Discriminatory (FRAND) terms needs to be preserved, as well as fair access to standards for all market players. The continued and effective protection of IP rights, including standard essential patents, is key to ensuring that European technology companies can earn a fair return on their investments and continue to bring innovative solutions. This is one of the key factors which EU companies need to pursue to develop their investment in open standardised technologies.

Prioritise and strengthen Europe's role and values in international standard development. A smart, focused, inclusive and balanced policy approach to European standardisation is needed. Incentives for innovators and technology-leading companies to participate in European standardisation activities in ETSI, CEN and CENELEC need to be maintained and strengthened, and standards activities need to continue to be industry-led. Advisory groups of the European Commission, governments and other political bodies should continue to include experts of non-EU stakeholders.

Global standards will be key for the green and digital transition going forward, because they ensure interoperability and economies of scale e.g., for next-generation networking technologies such as 6G and PON evolution. For the increasingly trade-relevant product circularity domain, European preferences for Digital Product Passports (DPP) should be internationalised with high priority.

The overall standard-setting approach and objectives need to be balanced with Europe's ambition of open strategic autonomy and economic interests.

In short, it is essential to ensure that international standards do not stray from core EU values built on WTO/TBT principles for international standards development. We also need to avoid a scenario where (national) standardisation in third countries, market access (EU FTA agenda), technology-specific regulation or government funding become vehicles for other jurisdictions to gain competitive advantage in innovation and commercialisation.

3) Realise the scale-up of investment-intensive innovation

To move forward with the green and digital transition we have to de-risk technology development through public-private partnerships and innovation-oriented public funding

True partnerships are key! To gather pace for the transformation of our industries and remain a global leader in the green transition, the public sector has to keep its sights on the scale-up phase of innovation. To some extent, it can do so by encouraging partnerships at company level or with research institutions to scale up (e.g. test beds), but efforts cannot stop there.

Especially for capital-intensive or infrastructure-demanding projects, hands-on public support is common in other jurisdictions which have long recognised that deploying the newest technology at scale – and fast – offers competitive advantages for their entire economy.

The unprecedented US Inflation Reduction Act only underlines that for large-scale innovation made in Europe to remain competitive – and indeed for European industry to remain competitive – Europe's leaders must adapt to global reality. Europe's decision-makers and public sector have to step up their support as partners to industry – without entering into a transatlantic and/or intra-European subsidies race.

For Europe, the minimum would be to support investment-intensive projects that respond to a real demand and would have immediate industrial applications. But public support / de-risking can also take the form of outright partnerships, targeted subsidies as well as economic or regulatory incentives that would allow companies to achieve scale-up faster and at a larger scale.

Pair-up public support with tax-based incentives for R&D activities to free up considerable company resources that could then be invested in the scale-up of more mature innovation projects.

The public sector could become a better customer for innovation. Beyond de-risking of deployment investment, public procurement is also an important accelerator of market penetration or replication of innovation.

Looking at past experiences, a European Sovereignty Fund may turn out to be a useful instrument to finance innovation, but the debate is at an early stage. An agreement on a new fund, its firepower and its conditionality, not to mention its actual set-up – are likely to take time and there is little guarantee that the new fund will not be beset by similar complexities as experienced for existing instruments.

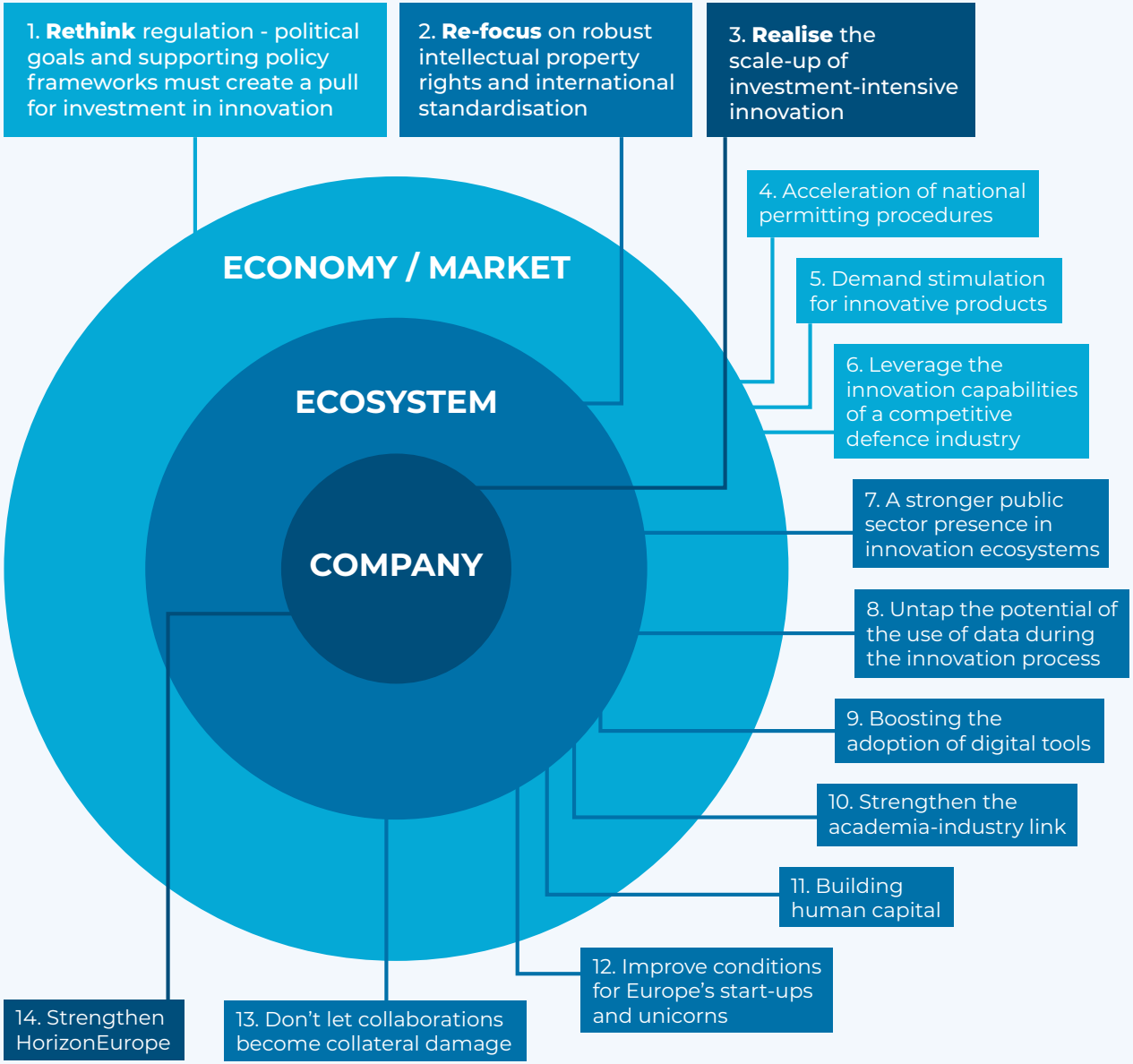
In this light, policymakers should keep it a priority to look closely into all other means to de-risk innovation in the short to mid-term. This would alleviate current pressures and provide further confidence in Europe's ability to act and support innovation.

Would de-risking generate more innovation? It certainly would. One obvious impact is that it directly frees-up private sector resources. Moreover, it would stimulate additional investment in new R&D projects: first, opportunity costs of innovation projects decrease; second, the business case for innovation improves because a larger scale can be achieved both more easily and faster. The latter is key in light of intense global competition for technological leadership.

All ERT policy messages

The **three ERT Priority Messages** highlight actions that are essential for boosting innovation made in Europe. Together they will create the dynamics needed to encourage innovation, and to do so with a lasting impact.

At a more detailed level, other factors also play a role. For more explanations on some aspects and related suggestions, please refer to our website.



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ERT Innovation Stories

Overview of all ERT Innovation Stories

34 Innovation Stories by 35 ERT Members*

Green Transition	Health & People	New Materials & Circularity	Digital Transformation
Electrified, automated Björn Rosengren ABB	**Innovation in the skies: the hydrogen revolution** Guillaume Faury Airbus	**Paint the future** Nils S. Andersen AkzoNobel	**The finest brush** Peter Wennink ASML
A global and equitable vaccine Leif Johansson AstraZeneca	**A long goodbye to animal testing** Martin Brudermüller BASF SE	**Calling out Covid** Timotheus Höttges Deutsche Telekom	**6G yes, but first the real 5G** Börje Ekholm Ericsson
The vaccines unlocker Jonathan Symonds GSK	**Zero compromise** Dolf van den Brink HEINEKEN	**To net-zero with CCUS** Jan Jenisch Holcim	**A giant leap to sustainable electrification** Hilde Merete Aasheim Norsk Hydro
A new vector for a decarbonised Europe Ignacio S. Galán Iberdrola	**Revolutionising the deep tech transfer** Jacob Wallenberg Investor AB	**Gravitas to the lightweight** Alessandro Profumo & Ilham Kadri Leonardo & Solvay	**Less is more** Jean-Paul Agon L'Oréal

*status March 2023

All hands on deck – bringing shipping to net-zero

A.P. Møller-Mærsk

Not only round but circular too

Florent Menegaux
Michelin

Food for thought

Mark Schneider
Nestlé

The need for speed

Pekka Lundmark
Nokia

Free cooling for green data centres

Christel Heydemann
Orange

Beating cancer with the help of data and AI

Roy Jakobs
Royal Philips

A lightweight revolution

Jakob Stausholm
Rio Tinto

A silent pandemic, screaming for action

Christoph Franz
Roche

A long journey to sustainable tires

Güler Sabanci
Sabancı Holding

Tracing the perfect circle

Christian Klein
SAP SE

Closing the plastic loop

Wael Sawan
Shell

Safer with AI

Jim Hagemann Snabe
Siemens

Smartening up your home

Cláudia Azevedo
Sonae

A 5G testbed for Industry 4.0

José María Álvarez-Pallete
Telefónica

Fueling energy transformation

Patrick Pouyanné
TotalEnergies

Recycling batteries – enabling e-mobility

Thomas Leysen
Umicore

Pushing doors open

Jean-François van Boxmeer
Vodafone Group

California dreamin': From innovation to deployment

Martin Lundstedt
Volvo Group

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Björn Rosengren
Chief Executive Officer
ABB

Carbon emissions

Product and Process

Customer demand

Cross-sector cooperation

Strong cooperation with external partners

Across several sectors

Electrified, automated

Mining remains an essential activity to sustain our modern lifestyle in the 21st century. Most of it, though, happens elsewhere, far from our immediate landscape. Smartphones, tablets, computers, batteries, wind farms, solar panels: virtually every aspect of modern life relies on ores mined from the earth – a situation that has only been intensifying with the green and digital transitions.

Since 2010, the average amount of minerals needed for a new unit of power generation capacity has increased by 50 per cent, as the share of renewables in electricity generation has risen.[1] This is significant, as the mining industry is responsible for up to seven per cent of all global greenhouse gas (GHG) emissions.

To sustain the energy transition, urgent and concerted action is needed to address emissions result-ing from the production of metals and minerals. Where is the starting point?

Electrifying a single mining truck eliminates the same amount of CO2 emissions per year as it would take 46,000 trees to absorb. If every truck in every mine were electrified, we could prevent 198,000 tons of CO2 from being released every day.

Decarbonising this sector means accelerating electrification, automation and digitalisation in un-precedented ways. Those three go hand-in-hand and we at ABB believe that electrification is the enabler. ABB Ability™ eMine, launched in September 2021, is an example of what the all-electric mine could look like, from mine to port.

Innovating mining

At the Copper Mountain mine in British Columbia, Canada, diesel consumption from haul trucks is the largest source of GHG emissions. This prompted operator Copper Mountain Mining to partner with ABB to reduce emissions from diesel trucks in open-pit operations at its flagship site. ABB's task was to deliver an open-pit haul truck trolley assist solution for hybrid-electric vehicles, equip-ping the trucks with a pantograph to receive external electric power. The trucks not only produce fewer GHG emissions but also travel faster on the ramp, boosting throughput. The trolley control system is connected to the existing ABB automation[2] platform to seamlessly integrate and monitor trolley operations and energy consumption.

ABB also unveiled its mining electric vehicle (EV) fast-charging pilot solution: ABB Ability™ eMine FastCharge, set to become the world's fastest and only fully automated charging system for mining trucks, offering up to 600kW of power.

1 IEA, The Role of Critical Minerals in Clean Energy Transitions – May 2021

2 ABB AbilityTM System 800xA distributed control system (DCS)

Moving the elephant

The decarbonisation of mines brings together multiple sectoral experiences such as electrification, process industry, measurement and analytics, digital and cloud connectivity as well as our decade-old experience in ultra-fast charging of vehicles.

As technologies such as onboard drivetrain components must be mature enough to be compatible or interoperable with charging infrastructure or battery swapping stations, collaborations with EV production platforms, original equipment manufacturers (OEMs) and technology innovators are key. Battery evolution is crucial, too, with requirements for high energy and power density, longer elec-tric range and low costs.

The main challenge when it comes to this type of innovation is “moving the elephant”. Decarbonising mining operations requires profoundly re-thinking connectivity, monitoring, cycle times and safety within a mine whilst collaborating with multiple partners and OEMs to ensure interoperability. Cutting this challenge into bite-sized problems and opening up to collaboration to ensure wide compatibility has been the key to delivering this innovation.

ABB has been closely collaborating with longstanding mining champions such as Boliden, OEMs such as Liebherr or Hitachi Construction Machinery, service providers like Perenti, and technology suppliers such as MEDATech and Stäubli, as well as with digital partners such as AWS.

In Europe, electrification of mining had already been successfully explored by ABB in cooperation with Boliden for mines in Sweden (Aitik) and Finland (Kevitsa).

Can we move the elephant in Europe?

Europe’s near-total dependence on critical raw materials imports is not sustainable. We need to ur-gently square the circle: revive Europe’s mining industry based on a modern, clean and less intru-sive model widely supported by the hosting local communities. We can only do that if we step up innovation efforts – and the promise is there: our technologies and concrete projects show that even elephants can be moved.

Then what do we need to achieve even better solutions? One lesson we learnt during the COVID-19 pandemic is that no innovation challenge is insurmountable when companies work together to-wards a clear common goal and with the broad support of policymakers and society.

Let us translate that to our situation. To deliver innovation that would revive mining in Europe, we need supportive and predictable policy goals to clearly define the challenges to be addressed and reliable criteria – and incentives – for the solutions we should develop for our customers. All three are essential for suppliers like us – and our partners – to point innovation efforts in the right direction and have our investments validated against a reliable long-term regulatory framework. If you want to start moving an elephant, you first and foremost need to know where to.

Guillaume Faury
CEO
Airbus

AIRBUS

Climate change

Product & manufacturing processes

CEO-set target
Decarbonation of aviation

Funding, regulatory environment

External suppliers, academia, public authorities

Innovation can be used for the transport sector and beyond

Depending on access to green renewable energy

Innovation in the skies: the hydrogen revolution

Decarbonising aviation is one of the biggest challenges of our time, with an impact not only on aircraft design but also on airport fuelling services and more. Air travel has been around for a century and, in that time, it has primarily relied on one form of fuel: kerosene. Pre-pandemic, Europe's airports welcomed over a billion passengers a year. How does the sector transform itself?

According to an independent study commissioned by the European Union's Clean Aviation Joint Undertaking, novel and disruptive aircraft, engine and systems innovations, in combination with hydrogen technologies, could help to reduce the global warming effect of flying by 100% net, by 2050.

This is why Airbus has set an ambitious target of bringing a zero-emission commercial aircraft, powered by hydrogen, to market by 2035.

The hydrogen challenge

Hydrogen is a high-potential technology for aviation. When generated from renewable sources, it emits zero CO2. Significantly, it delivers around three times the energy per unit mass of traditional jet fuel and more than 100 times that of lithium-ion batteries. This makes it well suited to powering aircraft.

However, storing hydrogen onboard an aircraft poses several challenges. At normal atmospheric pressure and ambient temperature, you would need approximately 3,000 litres of gaseous hydrogen to achieve the same amount of energy as one litre of kerosene jet fuel.

Clearly, this is not feasible for aviation. To reduce volume, we can dial down the temperature to -253°C. That's when hydrogen transforms itself from a gas to a liquid, increasing its energy density even more. Four litres of liquid hydrogen (LH2) would be equivalent to one litre of standard jet fuel.

Maintaining such a low temperature requires very specific storage tanks. Today's tanks consist of an inner and outer tank with a vacuum in between, and a specific material, such as a MLI (Multi-Layer Insulation) to minimise the heat transfer by radiation.

To store hydrogen onboard an aircraft, more innovative creativity is needed. The development and testing of suitable LH2 tanks requires a fundamental rethink of product architectures and materials science.

For Airbus to deliver a safe, economically viable aircraft by 2035, significant efforts are needed in all fields: research and development, investment and accompanying regulation.

Solution for wider challenges · Type of innovation · Part of an EU / national initiative · Cross-sectoral innovation · Trigger

Joining forces to tackle the hydrogen storage challenge

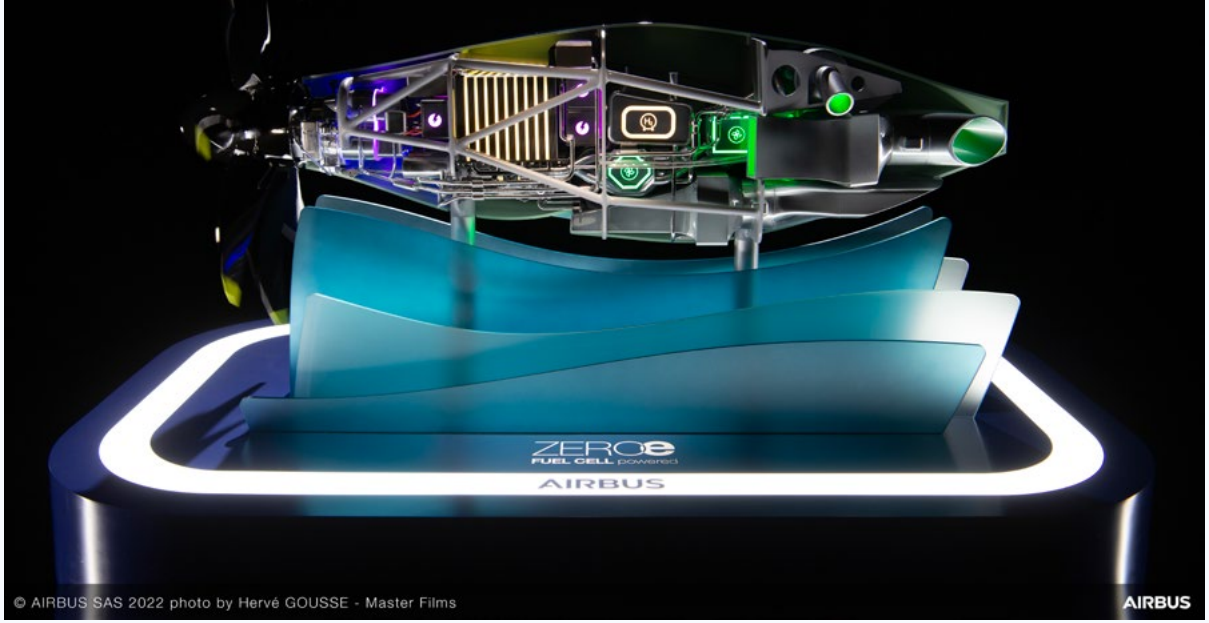
After a detailed analysis of technologies used in adjacent sectors, Airbus has sought collaborations with companies with proven track records in hydrogen storage. This includes Arianespace (space applications), Air Liquide and Linde (LH2 distribution and refuelling technologies), Shell (hydrogen supply chain infrastructure), as well as ENGIE and VINCI (clean hydrogen end-to-end supply chains) to name a few.

This collaborative approach has helped to accelerate knowledge exchange on systems installation, cryogenic testing, fuel sloshing management and even on how to design and build the LH2 tanks themselves.

To further accelerate progress, Airbus took the strategic decision to develop in-house expertise in the critical areas of materials science and testing infrastructure by establishing centres of expertise, known as Zero Emissions Development Centres (ZEDCs), in France, Germany, Spain, and the UK.

In the near term, LH2 tanks are likely to be made from metal, but the long term goal is to use composite materials that will be lighter and more cost-efficient to manufacture. Equally crucial to the performance of a future hydrogen aircraft will be the end-to-end fuel systems.

Alongside Airbus' own significant investment, financial support has been received from regional authorities, notably in Pays de la Loire, Occitanie, and Bavaria. In the future we might see support through the European Commission's important projects of common European interest (IPCEI).



A new prototype LH2 tank – ready for testing

Phase One of the project has been completed successfully. For the first time, a LH2 tank has been designed and built in Europe – only one year into the programme.

These tanks are now prepared for rigorous testing, but we can already say that the work carried out at the ZEDCs is going a long way to de-risk the use of hydrogen in commercial aircraft operations. It is expected to provide a very significant benefit to the broader aerospace ecosystem, including for airlines and airports, as well as the wider supply chain.

The knowledge gained could also support the wider transport sector, including road haulage, trains and shipping, as well as adjacent industries that consider hydrogen as a way to decarbonise their activities, including high-value chemicals and heavy industries such as steel and cement.

Unlocking hydrogen's potential

Airbus is fully committed to developing the world's first zero-emission commercial aircraft by 2035 – and to the significant investment and cross-industry collaborations that are and will be necessary within an incentivising policy framework.

We believe that hydrogen has the potential to make this vision a reality – but there is one major caveat: Our success depends on the availability of sufficient quantities of cost-competitive hydrogen from low-carbon sources, powered by renewable or nuclear energy.

With increased public and private support, leveraging flagship initiatives such as the Clean Aviation Research Partnership and the Alliance for Zero-Emission Aviation, the technology pathways can be de-risked more quickly.

With commitment from Airbus, and the whole stakeholder community, the hydrogen revolution for aviation is becoming a reality.

Nils Andersen
Chairman
AkzoNobel

AkzoNobel

	Green Deal, climate change, circularity
	New materials and processes
✓	
✓	
	Customer & societal expectations, competitiveness
	Cross-sector and value chain cooperation, funding, commercialization
✓	External partners; start-ups, value chain, EU programs
✓	Value chain collaboration of relevance to all sectors
✓	(Provided the conditions are right)
👍	(Yet we could do better and achieve more together)

Paint the future

You can almost always find yourself within touching distance of a paint or coating. For example, on consumer electronics, vehicles, batteries, furniture and buildings. The future demands more sustainable solutions and new ways of working from us. By delivering specific functionalities like heat absorption or special protection, our solutions are often an enabler for sustainability. Moreover, we are working hard designing coatings that are based on bio-based or other new materials.

To make these developments possible, we need to innovate in collaboration within our whole value chain – from start-up to bulk raw material producer and from science to applied technology. That is why we launched our Paint the Future initiative.

Shaking up the mix

We are convinced that there is huge potential in open and collaborative innovation, just waiting to be explored and nurtured. Our Paint the Future programme has already resulted in a number of exciting new partnerships with start-ups in and outside our sector, while at the same time strengthening our existing links with universities.

It is amazing to see how unexpected combinations – with start-ups that come from a completely different background – can end up providing additional functionalities for our product.

With Aerones we are working on a robotic solution to wind turbine maintenance. With Alucha we are recycling paper sludge as an ingredient for paint. With Les Companions we are testing a painting robot for interior walls.

Together, we accelerate the most promising sustainable solutions, where AkzoNobel as a multinational can provide expertise to help start-ups grow and gain market access.

Challenging the value chain

Involving our customers and suppliers is an equally important way to support implementation of new and more sustainable technologies. Achieving decarbonisation is a driving force behind our Collaborative Sustainability Challenge. Together with our extended value chain, we identify hacks to overcome implementation barriers. Policymakers have an important role to play as well – stimulating a common understanding of the value chain challenges and acting as a facilitator and regulator.

Pooling resources for the biggest steps

In research between industry and universities, it is important to find the best mix of science and applied research. EU and Member State funding has been instrumental in bringing together European partners (companies, academia, institutes) to work on sustainable solutions.

With the Advanced Research Center Chemical Building Blocks Consortium (ARC CBBC) in the Netherlands we are working on new ingredients and functional materials. With the HorizonEurope project Envision, energy is harvested from building surfaces by absorbing infra-red light. And with The Clean Sky 2 Ecotech project we enhance introduction of chromate-free treatments and primers for aerospace.

Now we need to ensure public support doesn't stop there but is extended to bringing products to market and finding additional European partners.

A better European blend?

In order to further strengthen European innovation in the area of paints and coatings, and harvest all the benefits of collaborative innovation, we need the public sector to increase their involvement as partners in the value chain.

Public involvement in the search for new sustainable (raw) materials is crucial to taking the first step toward decarbonisation of materials.

Furthermore, public involvement will be vital to help bring sustainable solutions to the market, by addressing barriers to implementation. Together we can paint the future!

Peter Wennink
President & CEO
ASML

ASML

All societal challenges	
Product	
No	✓
Yes	✓
Pushing the boundaries of technology	
Developing completely new technologies	
Creating an ecosystem	✓
	✓
	✓
	👍

The finest brush

Chips are everywhere – most modern technology relies on them to the extent that most of us cannot even imagine a world without semiconductors. Just think of modern cars, phones, household appliances. The technology required to manufacture those chips is pushing the boundaries of science to new and unchartered territory.

The long-term growth of the semiconductor industry is based on the principle that the energy, cost and time required for electronic computations can be reduced by shrinking the transistors on microchips. One of the main "drivers of shrink" is the density – and hence miniaturisation – of transistors on a chip, which depends on the smallest feature resolution that lithography systems can achieve.

Lithography resolution is mainly determined by the wavelength of the light used and the numerical aperture of the optics. A shorter wavelength – like a finer brush used for painting – can print smaller features. A larger numerical aperture can focus the light more tightly, which also leads to better resolution. Building lithography machines has been an innovation challenge from the beginning.

Painting with the finest brush

ASML is a global innovation leader in the chip industry and provides chipmakers with hardware, software and services to mass produce patterns on silicon through lithography. Our lithography machines are not one innovation – they bring together countless innovations by us and our suppliers, each pushing the envelope on what can be technically achieved to obtain maximum precision.

To keep moving the needle in enabling ever faster and less energy-intensive microchips, we have to relentlessly drive our technology forward. When we set out to develop the latest generation of lithography machines capable of the highest resolution, we had to learn how to harness light with an extremely short wavelength – Extreme Ultra Violet (EUV) light. This was pioneering work in many respects and all in all, it took well over a decade of tenacity to get our EUV technology off the ground.

The tricky thing with harnessing EUV light for lithography is that it is absorbed by everything, even air. That is why our EUV system has a large vacuum chamber in which the light can propagate far enough to land on the wafer. The light is guided by a series of ultra-reflective mirrors, made by our German partner ZEISS SMT. These mirrors are so smooth that, if they were to be scaled to the size of Germany, the biggest bump would be less than a millimeter high.

And EUV light is also notoriously hard to generate. Our EUV system uses a high energy 30-kilowatt laser that fires on a microscopic droplet of molten tin 50,000 times per second, turning it into plasma that emits the EUV light, which then is focused into a uniform beam.

EUV lithography is now being used by the world's largest logic and memory chipmakers. We continue to push the roadmap for this

Solution for wider challenges · Type of innovation · Part of an EU / national initiative · Cross-sectoral innovation · Trigger

technology for years to come, delivering systems with higher productivity and better imaging performance. These advances in lithography enable the industry to continue increasing the value and lower the cost of a chip – setting a basis for innovation in many other goods (e.g. phones) that become affordable for many more people.

An ASML ecosystem

We could never have achieved this alone – so we have learned to rely on others, too. For this we tap into the collective knowledge of our global ecosystem across suppliers, academic partners, customers and peers. Our ecosystem approach has led customers to co-investing in EUV with us, as well as a renewed partnership model with ZEISS SMT, our trusted partner for optics. We have also made acquisitions that boosted our capabilities across our product portfolio.

As a company we foster an environment where people can contribute, learn and grow, because we believe our purpose is to unlock the potential of people and society by pushing technology to new limits. But we also know that innovation is rarely a straight line. It takes laser focus, multidisciplinary teamwork and a keen eye for how we can best help our customers. And even then, we have had to show resilience.

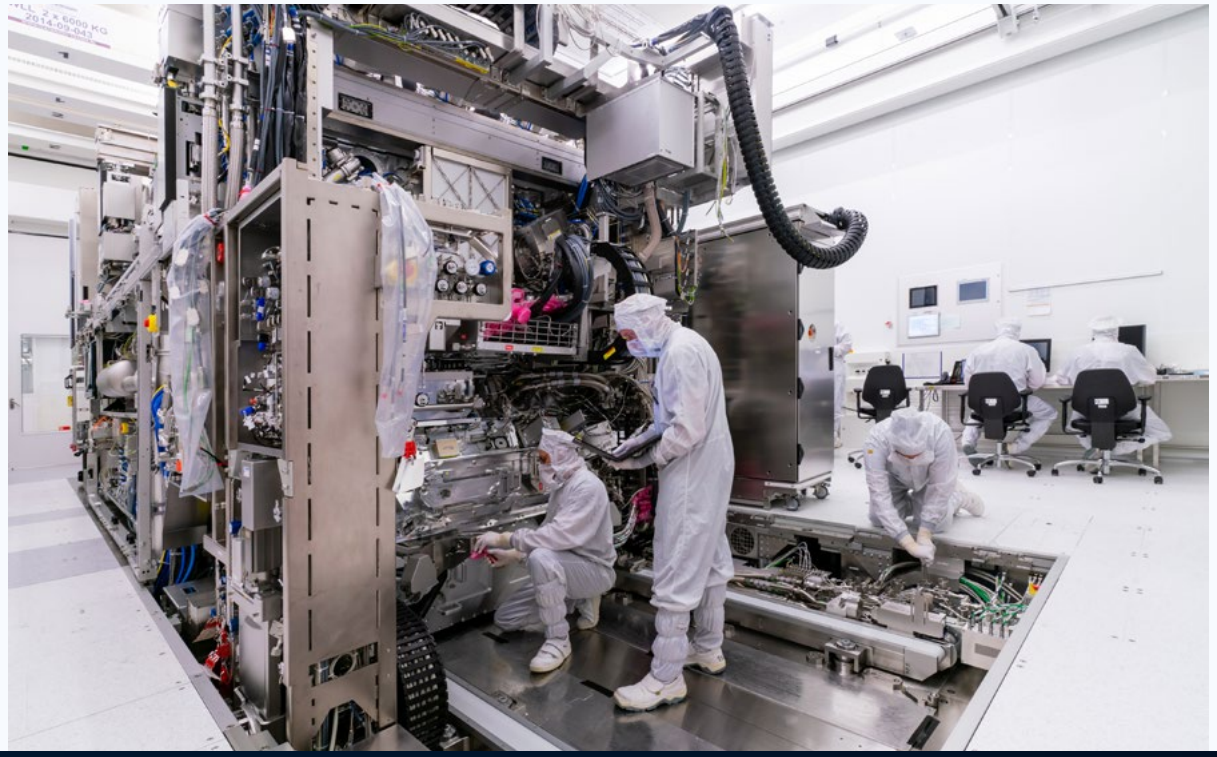
Why Europe?

There are various reasons why ASML could be created in Europe – or more specifically in Veldhoven in The Netherlands, but the most important one is the European willingness to cooperate and share risks and rewards. This holds true for cooperations between companies, universities, governments and research and technology organisations.

The EU internal market and the collaborative spirit between system integrators and technology suppliers in the EU is what has made ASML a success story and it has brought many SMEs/startups across Europe to the next stage, employing thousands rather than dozens.

Europe has what it takes to build and maintain technological leadership – and Europe benefits from this. The innovations that our technology enables are key to develop solutions for our own continent: renewable energy, health, new modes of transport, education, (tele)communication and new forms of computing. And yet, without reliable access to state-of-the-art equipment, a chip production ramp-up would become much harder to achieve, leaving the fate of European industries increasingly in the hands of third countries.

Excellence in advanced semiconductor equipment and production process development provides us with global leverage in a world which is breaking up into socio-economic blocks. The technology that we at ASML enable has become of strategic importance – to the extent that semiconductor technology is now posing challenges for our trade relationships. Innovation has dealt us strong cards which, if we use them wisely will contribute to Europe's strategic autonomy and place in the world.



Leif Johansson
Chair
AstraZeneca

AstraZeneca

Global pandemic

Product

Not part of a public initiative

Public demand

Slow review process, lack of harmonisation of standards

Academic, private sector, and government

(Still need early investment in development and manufacturing by governments)

A global and equitable vaccine

In the very early stages of the COVID-19 outbreak in 2020, it became clear that the pandemic could only be effectively tackled with a vaccine that would be broadly and equitably used across the globe.[1] This is the challenge we set ourselves when partnering with Oxford University to produce and supply a COVID-19 vaccine at no profit.[2]

The result was a vaccine developed in less than a year, with over 3 billion doses released for supply to more than 180 countries.[3] Based on data published in The Lancet[4] and a modelled outcomes analysis by Airfinity, the vaccine is estimated to have helped save over 6 million lives in the first year of vaccination.[5]

AstraZeneca was the first and largest contributor in 2020 and 2021 to the public-private COVAX initiative co-led by Gavi, the Vaccines Alliance, the World Health Organisation (WHO) and others, to enable global equitable access. We also worked with COVAX to facilitate donations of our vaccine from EU Member States around the globe.

Partnerships as the foundation

Effective public-private partnerships were critical to our response. Our partnership with Oxford University allowed us to pool world-renowned expertise in vaccinology with large scale manufacturing at a critical moment in the pandemic.

Partnerships with governments, including with the European Commission, together with the Coalition for Epidemic Preparedness Innovations (CEPI), supported R&D and manufacturing through Advance Purchase Agreements (APA).

We shared the vaccine technology with more than 20 different supply partners across the globe, finding and training contract manufacturing organisations (CMOs), and forging regional sublicensing agreements in countries with significant manufacturing capacity.

1 https://www.ox.ac.uk/news/2020-04-30-oxford-university-announces-landmark-partnership-astrazeneca-development-and

2 https://www.astrazeneca.com/media-centre/press-releases/2020/astrazeneca-and-oxford-university-announce-landmark-agreement-for-covid-19-vaccine.html#

3 https://www.astrazeneca.com/media-centre/medical-releases/vaxzevria-shown-in-expert-review-to-provide-equally-effective-protection-against-covid-19.html#:~:text=AstraZeneca%20and%20its%20global%20partners,and%20lower%2Dmiddle%20income%20countries.

4 Watson OJ, et al Global impact of the first year of COVID-19 vaccination: a mathematical modelling study. Published on line June 23, 2022 Available at: https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(22)00320-6/fulltext [Last accessed: October 2022]

5 Data estimates based on model outcomes from separate analyses conducted by Airfinity and Imperial College London, United Kingdom. AstraZeneca Data on File. DoF REF-156573, 11 July 2022

Looking to the future

What learnings can we take away from this success? Extending the European Medicines Agency's (EMA) rolling review process beyond the exceptional COVID circumstances would be of immediate help and could encourage additional research projects to address other health needs.

Meanwhile, policymakers should continue developing an enabling environment for innovation.

This should, firstly, include investments in manufacturing infrastructure and trained personnel (an "army reserve" for pandemic preparedness) to support successful technology transfer. In addition, early investment in development and manufacturing by governments in collaboration with industry will secure capacity and enable access, as we saw with the Biomedical Advanced Research and Development Authority (BARDA) in the US. We believe the Health Emergency Preparedness and Response (HERA) can play a similarly important role in the EU.

Secondly, further harmonisation of standards would enable even quicker access to markets. Here too, the EU can play an important role by working with health authorities worldwide to achieve efficient regulation.

Thirdly, improved digital infrastructure is also critical to accelerating clinical trials. We need to continue investing in data governance and systems required, including the creation of a European Health Data Space. This will support strong evidence generation, and further accelerate development timelines.

We believe the EU has a key role to play in improving public health globally. In addition to determining short- and long-term policy fixes, policymakers should continue to seek and drive equitable access to health solutions by partnering with industry and stakeholders across the healthcare ecosystem, as was done during the pandemic with the vaccine. It may not be able to stave off future pandemics, but it will at least leave us better prepared and equipped.

Dr Martin Brudermüller
CEO
BASF SE

BASF
We create chemistry

- Animal welfare (resource scarcity), health
- Product
- ✕
- ✕
- Regulatory
- Permitting / regulatory environment
- ✓ Other corporates and academia
- ✓ Across the whole chemical sector
- ✕ (Commercialization is not the goal)
- (External approval process remains cumbersome)

A long goodbye to animal testing

In the chemical sector the safety of our products is key and before chemical substances reach the market, they must undergo rigorous assessments. Animal testing is the traditional, regulatory accepted model to observe adverse effects of substances on human health. With the EU's Chemical Strategy for Sustainability the need for testing is bound to increase.

Yet animal testing is highly problematic from an ethical perspective and large parts of our society strongly oppose it. Unless we can replace animal testing with credible and reliable alternatives, those competing priorities will keep posing a dilemma for policymakers, regulators and industry alike.

What if we didn't need animal testing anymore? Developing and implementing alternatives to animal testing has long been high on the industry's agenda – even more so as alternative testing methods can outperform animal testing. In fact – with the right non-animal testing methods we shed light into what used to be a black box of complex physiological processes. BASF, as one of the largest applicants for registrations of substances worldwide, is a great believer in this way forward and has invested significantly in the area.

The big question now is whether Europe's policymakers and regulators will seize the opportunity to revolutionise testing regulation and open a path to the future.

Opening the black box

BASF has been developing non-animal testing methods for many years and implements them whenever it is legally compliant and scientifically sensible. We have been running our own laboratory for the development and application of non-animal methods since 2004 and each year we invest a 7-digit figure in the development of those methods (e.g. €3.5 million in 2020).

Why do we invest in this? First and foremost for ethical reasons: to reduce the number of animals needed to test for human health safety. However, we also see that non-animal testing methods can be superior as they tend to allow a level of precision in chemical safety assessments that animal studies simply do not offer. For instance, they allow toxicologists to better understand the mechanism of toxicity: whilst animal tests merely show whether a substance is toxic, they cannot model details such as human genetic backgrounds. Providing information on different effects for differing genetic constitutions is a value added of non-animal models.

How to create alternatives to animal testing?

For this to work, we needed to change perspective. Instead of developing a one-to-one alternative for each animal test separately, we needed to look at the non-animal methods first and put their potential at the centre of developing a new approach to risk assessment.

In undertaking all of this work we at BASF and our partners are not aiming for commercialisation or exclusivity. The results of this innovation are open to all.

Paving the way

In 2008, it became clear that new EU rules would prohibit animal testing in approval processes for cosmetics. This led us to focus on testing methods for sensitisation (i.e. allergic skin reactions) which is the most frequent occupational illness in the chemical sector. This was a joint effort with other companies (P&G and KAO/Shiseido) and academia (RWTH Aachen). The most difficult task was to choose the right non-animal testing methods to obtain as-complete-a-picture-as-possible for all key events in the sensitisation process and combine them into a testing strategy. In the end, a combination of three in-vitro tests and a new Kinetic Direct Peptide Reactivity Assay (KDPRA) made it possible to assess not only the potential for any skin sensitisation, but also provide information on potency.

We knew we had succeeded when the OECD approved our new testing strategy and a new global standard was created that substitutes animal sensitisation tests for all OECD member countries.

In 2021, we saw another breakthrough towards the acceptance of alternative methods: the OECD adopted the world's first toxicology testing strategy that does not involve animal testing, developed over ten years by BASF together with Givaudan. This testing strategy assesses skin sensitisation and has an even better predictivity for human allergy than traditional animal testing.

Is the EU ready to re-think and replace animal testing?

Well-designed non-animal testing methods allow for the highest level of human health safety. The challenge is that a switch in methods depends on a 're-think' by policymakers and regulators – and this is not happening fast enough.

Hurdles remain high for alternative methods to be picked up by regulatory application: provisions in regulatory frameworks are still based on animal testing and/or approval processes for new methods are lengthy and complex.

A European action plan could change this, led by EU and national authorities and jointly developed and supported by all stakeholders. The goal of this action plan should be to define priorities for the development of future non-animal methods and to describe respective coordination and financing processes. A pledge by authorities to substitute rather than complement should be included as well.

Replacing animal testing with innovative methods would make the world a better place – a worthwhile reason for regulators, policymakers and industry to pull in the same direction. The upside of substituting overcome testing methods is crystal clear: replace the black box with new, superior, knowledge-enhancing approaches. The downside of continued delays is also obvious: why invest in innovation and strive for constant improvement, if achievements cannot be put to use because rules do not adapt to new realities?

Let's not lose any more time and innovate testing methods AND regulation.

Timotheus Höttges
CEO
Deutsche Telekom

	Digital, health
	Application
✓	
✓	
	Government request
	Generating trust in a privacy-conform solution
✓	With technology company, government, etc.
✓	
✓	From national to European to global
✓	(The Covid crisis was a special situation that accelerated development)

Calling-out Covid

At the beginning of the COVID-19 pandemic, governments in Europe had to rely on traditional contact tracing, mainly carried out via phone interviews. With the pandemic spreading more rapidly every day, this was no longer a sustainable solution and the need to develop digital contact tracing became increasingly clear. Building an enabling infrastructure would soon become an urgent priority across Europe.

In early May 2020, the German government reached out to Deutsche Telekom and SAP with a request to develop an official COVID tracing app. After only six weeks, the Corona Warn App was released, the largest open-source project ever implemented in Germany on behalf of the government. And it had a real impact: it was downloaded more than 48 million times and roughly 57 million warnings were issued, due to a close contact to an infected person.

It's all about trust

From the start of the development of a tracing app, we faced the challenge that many people were concerned about the processing of personal data and potential risks related to privacy. A loss of confidence among the public would have endangered all success in identifying and breaking infection chains early on. Building trust in a secure and privacy-compliant solution was therefore key.

In addition, we were working against the clock. The development process naturally attracted public scrutiny, whilst the pandemic and its impact meant that time was of the essence. Yet, the project required intensive coordination between several players, amongst them the government, national health authorities and third parties including the providers of the major smartphone operating systems.

To address these challenges, the project was set up by Deutsche Telekom and SAP in a fully transparent and integrated manner. Work took place virtually, based on agile working methods that allowed for rapid iterations and product delivery. To involve the public and proactively address existing concerns on data privacy, essential information was shared from the start.

The entire software code and work process was published on an open-source platform (Github.com). This empowered experts as well as the broader public to review the functionality of the application and to submit comments. Over the development process, more than 100,000 people viewed the software code and 7,250 people actively participated.

Moreover, the Corona Warn App was the first European app based on a decentralised approach. Random identification numbers are exchanged between devices via Bluetooth, which makes it impossible to identify the individual behind the code. Decentralised data storage on user devices guarantees data privacy. No personal, geo-location, or other location data are sent or stored.

Tracing the virus – across the EU and globally

While many countries developed their own national tracing apps, there was a strong demand for cross-border tracing within the EU. Building on the successful cooperation in Germany, the European Commission requested SAP and Deutsche Telekom's subsidiary T-Systems to support the development of

a solution for cross-border COVID tracing. Considering the very high European standards on data privacy and security, the team of T-Systems developed a technical concept for a European Federated Gateway Service (EFGS), which acts as a European trust anchor and distributes the required health data across the EU. This concept prevailed against alternative concepts from Google, Apple, Spain and Italy and was implemented by T-Systems and SAP. Hereafter, T-Systems and SAP also developed the EU Digital COVID Certificate (EU-DCC) based on radical new European technologies like an efficient high-security digital envelope with innovative compression methods, as well as very high storage and access efficiency, featuring offline verification and extreme reliability.
The success of this project was praised by the European Commission, citing it as an example of Europe becoming a global standard setter in digital health .

Indeed, in February 2022, the World Health Organization (WHO) commissioned T-Systems to bring a similar solution to the global level making it easier for WHO members to introduce digital vaccination certificates in the future. T-Systems' gateway will enable the exchange of digital documentation of COVID-19 Certificates globally – and become a standard procedure for vaccinations against other diseases such as polio or yellow fever.

Lessons learned: How to drive innovation and successful digitalisation in the health sector

The development of COVID-19 tracing apps and related gateway solutions shows that in Europe it is possible to spur innovation, preserve fundamental values and set a global standard – all of this on an ambitious timeline.

What did we learn? First, trust in data protection and security is key to protecting the app's end-users and to encourage wide-spread adoption. Second, transparency and the use of Open-Source solutions enable buy-in from experts and the wider public, allowing for a participatory development process. Third, Europe can set a global standard in record time – provided all relevant actors join forces behind a shared mission – in our case governments, national health authorities, industry, and civil society.

However, innovation should not stop here. We should build on the lesson's learned and use this experience to further drive digitisation of the health sector and beyond. The Corona Warn App has been designed with citizens in mind. It is easy to access and understand, technically stable, performant, and meets the highest standards of security and data protection. As a result, it has gained widespread acceptance.

In a first step, we could build on this to develop similar health application platforms for digital vaccination passports. Vaccination certificates and prescriptions could be stored on such an app while ensuring privacy and user control over personal health data. In a second step, these solutions could be extended into a comprehensive European health app: Europeans could centrally access their proof of insurance, existing prescriptions and medical records at the touch of a button.

Moreover, by making such an application interoperable and linking it with other services such as digital citizen identities (e-ID), a personal wallet (e-wallet), or a digital citizen account, its use can be extended towards a variety of public services, accelerating the digital transformation of the public sector at large. Old-fashioned, laborious, and analog processes would finally be transformed into cost-effective and easy-to-use digital processes.

COVID-19 has shown what is possible with an ambitious mindset, transparency and public-private sector cooperation. We now have an opportunity to ensure that this does not remain a one-off activity in response to a crisis but can be an example for projects to come. By building on the solutions and lessons learned during the pandemic, we can use this experience and turn it into a driver for the digital transformation in Europe.

Börje Ekholm
President & CEO
Ericsson

ERICSSON

Digital transformation

Digital infrastructure

Ensuring Europe's future competitiveness and digital sovereignty.

Limited investment incentives

Enables digitalisation and innovation across industry

6G yes, but first the real 5G

Network capabilities have grown exponentially for decades laying the ground for advancements in digital innovation. 1G made communication personal: we stopped calling places and started calling people. 2G enabled digital voice, 3G made mobile data possible, and today's app economy depends on 4G. They will continue to do so – with each generation building on the last one.

Many now focus on the promise of 6G – but the world needs a step-change toward the real 5G first. 5G isn't just the most recent generation of mobile networks – it is transformative: an open innovation platform, capable of having an exponentially positive impact on our society, economy, and transition towards a greener future.

The 5G promise – making it real

At Ericsson, we believe that the instruments of 5G-enabled digital innovation, with faster speed, better latency, and the capability of network slicing, can be achievable on a global scale. But to get there, and to achieve that potential, 5G needs to be built right, both ensuring ubiquitous coverage as well as the right capacity through mid-band coverage and the functionality provided by 5G standalone.

With such a step change in 5G, billions of connected devices can gather and share information in real time; production lines can be capable of predicting and preventing interruptions before they occur; and industrial processes can transform to cut carbon, thereby contributing to the Green transition. Not only does 5G provide for economy wide innovation today, but it is also the foundation upon which 6G will be built, where the digital and physical worlds will combine. 6G is an evolution of 5G; if we don't urgently build out 5G, we will not even have the ecosystem needed to benefit from 6G.

Towards 6G: 5G is a step on the way

Critical to the 6G innovation are the 5G application programming interfaces (APIs) that can enable new services and anchor networks within the edge computing ecosystem. We are already witnessing significant evolution. In the 4G era, sophisticated communication platform services (CPaaS) were developed throughout the digital ecosystems enabling innovative SMS, voice and video capabilities. As 5G networks are built out globally, the opportunity for exposing 5G capabilities to developers is increasing.

With real 5G and network slicing, the next generation of CPaaS can leverage unique network capabilities to make networks a key driver of enterprise digitalisation. These APIs simplify the complexity of the underlying network, thereby enabling a vast developer community to drive innovation. This is a fundamental change, achieved by harmonising the exposure of APIs in 5G networks together with service providers to enable developers to innovate at scale, launch differentiated services, and thereby drive incremental revenues for the entire digital ecosystem.

5G Innovation leader & implementation laggard: Europe at a tipping point?

Europe needs a step-change. 5G has to be urgently and extensively deployed. The stakes are high: McKinsey estimates that 5G and other advanced technologies could contribute up to €4 trillion to the global economy by 2030. Europe's future competitiveness and digital sovereignty will be compromised if it continues to lag in the critical standalone 5G digital infrastructure which should be of concern to all industrial sectors and policymakers. That lag will make it harder for Europe's industrial base and small and medium enterprises to create a meaningful share of future jobs. And much of the €4 trillion of value will migrate to those countries and regions that lead the connected economy. And it will delay the horizon for 6G.

As we navigate through the 5G era, Europe's starting position is of major concern. The paradox is that some of Europe's main competitors in Asia, the Gulf and the Americas are racing ahead with digitisation using innovative European network technology. It is noteworthy that across all frontrunner countries, mobile markets have consolidated, establishing sustainable and competitive market structures where firms are incentivised to invest.

In Europe, three years after the launch of 5G, only 7% of existing 4G base stations were upgraded to 5G on the critical midband.[1] The US, China, South Korea, the Gulf states, and Australia are already far ahead,[2] and India, where 5G was only launched in Q4 last year is expected to leapfrog Europe by Q4 this year. This means that priority must be given to actions that close this gap.

Those that can innovate in the digital economy have the best chance of creating job opportunities for the future. These jobs will in turn drive more innovation creating a new digital virtuous circle. But these advancements in digitisation will not be achieved without a step change in connectivity.

What has to change

Europe has a robust base for innovation: a strong education system including great universities, a large common market, and a stable political system. But European innovators lack the digital infrastructure. Would there be automotive industry without roads? Let's now build the road towards 6G by enabling the real 5G.

To make this happen, European policymakers should look at the wider environment. They should consider allowing for sustainable market structures to evolve via in-market consolidation. Maximising spectrum release, extending license durations and trading off fees for deployment commitments, would also help. Moreover, it would be key to remove artificial hurdles that delay or add cost to infrastructure deployment.

One innovation lesson is that, sometimes, 'everything must change for everything to remain the same'. Unless Europe creates an environment in which 5G can be implemented to the fullest – and fast – our leadership in innovation is at risk.

1 https://5gobservatory.eu/observatory-overview/eu-scoreboard/

2 https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=74383633&file=101122-Competition-Dynamics-in-Mobile-Markets.pdf

Jonathan Symonds
Chair
GSK

GSK

Health

Product, technology

Strategic decision

Regulatory challenges, manufacturing

External partners (researchers, academia, private foundations)

(At that time)

The vaccines unlocker

Vaccines have transformed modern healthcare and are one of the most life-saving public health interventions in history: WHO estimates that immunisation saves the lives of 2.5 million people each year and protects millions more from illness and disability.

Yet, some fundamental scientific challenges remain in the field of vaccine technology. A vaccine stimulates the body's immune response against a specific pathogen. This response must be strong and long-lasting enough to ensure high and long-term efficacy.

Our journey to understand how new scientific and technological advancements could make vaccines even more effective and immunisation last longer ultimately led us to look into adjuvants technology. Adjuvants are substances added to an antigen (the active ingredient in a vaccine) that can enhance the body's immune response. On this basis we developed our first adjuvant technology, the Adjuvant System 01 (AS01).

The adjuvant breakthrough

Adjuvant technology potentially allows us to decrease the quantity of antigen needed for each vaccination dose, therefore enabling manufactured volumes to go farther. This is particularly important in a pandemic/health crisis where demand can rapidly exceed supply. Moreover, they may help activate an equally effective immune response in people of all ages.

AS01 was initially researched to support the discovery of the first licensed malaria vaccine. This vaccine is currently being rolled out to help protect children in Sub-Saharan Africa, with the support of WHO, GAVI and UNICEF.

The implications go far beyond combatting malaria. This same adjuvant has also been investigated and proved to have potential in other disease areas with major global health impact, such as tuberculosis, herpes zoster and respiratory syncytial virus (RSV) in older adults.

In short, we now have the technology to be able to develop new vaccines that have the potential to help achieve broader, longer-term, more persistent protection.

A thirty year journey

AS01 is an example of ground-breaking science, developed by our GSK teams and partners in Europe, with the potential to save hundreds of thousands of lives. It is also an example for how long such journeys can take: our research in this technology took over three decades.

The core of the science was developed in our R&D hub in Rixensart in Belgium, where we have a long history for vaccines R&D, dating back to 1958 and collaborations with an extensive network of European universities and biotech companies.

AS01 was discovered and developed by combining expertise from GSK scientists and external researchers. Its success relied on several factors.

First, we have built strong partnerships with scientific researchers and academics. Particularly, we collaborated with external partners on the preclinical and clinical evaluation of the adjuvants to understand better their effects on immune responses and their mechanisms of action.

Second, we received support from private and public initiatives at an early stage (such as the Malaria Vaccine Initiative – MVI – from the EU Commission, the Gates Foundation and PATH).

Third, our regulatory authorities showed great openness to assess new technologies and upskill to understand how this new innovation could benefit society.

Fourth, we were able to build global collaborations, including with the US, to advance the science into development and commercialisation.

How to remain a leader in innovation?

At GSK, we unite science, technology and talent to get ahead of disease. For Europe to remain competitive, and to be the home of innovation, like adjuvant systems, we need to boost the innovation ecosystem. In an era where global competition to attract talent and innovation is increasing, Europe risks losing its place as a global research hub if it does not create an environment where innovation is encouraged and enabled to flourish.

European policymakers need to act, if we are to preserve our global competitiveness in research and innovation in health:

Europe needs to invest more and better in skills and public-private partnerships. The wealth of scientific expertise in European universities has been essential to advance the science behind adjuvant technology. Today, Europe is experiencing a shortage of skills, with talent heading to other geographies. Europe needs to invest to attract and retain high-quality scientific expertise and maintain a framework which facilitates partnerships, both public and private.

Moreover, pharmaceutical research needs better incentives. The journey of scientific discoveries and development of new technologies is long, costly, high risk and often non-linear. Outcomes may reach beyond the initial focus of the research: AS01 proved to be successful well beyond malaria where it was first researched. However, during the course of the development of AS01, we also invested in researching many more adjuvant systems, some of which did not prove successful. A robust IP framework remains foundational in providing a predictable operating environment conducive to such high-risk investments.

Alongside a robust IP framework, we also need a regulatory system that is agile and able to help accelerate approval of innovation in Europe and keeps pace with rapidly developing new technologies. A fit-for-purpose regulatory framework – based on enhanced regulatory capabilities and regulators' willingness to implement new innovations quickly – could significantly help accelerate innovation in Europe.

Finally, digitalisation is transforming the way we research and discover new medicines and vaccines. But for this we need appropriate digital infrastructure and should also optimise access to and use of health data for research.

Europe still is globally competitive in research and innovation in health, but we must not take our competitiveness for granted. It is easier to future-proof an innovation ecosystem from a position of strength, than to play catch-up once leadership has been lost.

Dolf van den Brink
Chairman of the Executive Board and CEO
HEINEKEN

HEINEKEN

	Public health
	Product
✕	
✕	
	Consumer and stakeholder demand, company responsibility ambitions
	Preserving product quality and taste
✓	Internal, academia
✓	Enabler of a vibrant 0.0 market across Europe
✓	
	Narrow focus of public programmes

Zero compromise

Promoting moderation and addressing the harmful use of alcohol is an important societal challenge. The World Health Organisation (WHO) has called for a shift in consumption to low-alcohol products, as part of their global strategy for alcohol. As a responsible brewing company, contributing to this moderation agenda has long been a core priority for HEINEKEN.

Alcohol-free beer plays an important role by offering consumers a choice for every occasion. Research[1] commissioned by the European Commission has demonstrated that the purchase of no-alcohol beers leads to long-term behaviour change towards lower alcohol consumption. However, producing alcohol-free beers that live up to consumer expectations is not an easy task – which is probably why, in the past, alcohol-free beers were a rather niche product.

To make a real difference, we had to create a true gamechanger: a high quality, great tasting alcohol-free beer that provides the same consumer experience as our other brands. By innovating in this area, we aimed to provide a real choice for the growing numbers of adults who either do not drink, want to reduce their alcohol consumption or who are looking for attractive alternatives for key occasions.

As a result, in 2017, we launched Heineken 0.0, a zero-alcohol extension of our flagship global brand. Since then, we have continued to invest in and drive the brand, and today Heineken 0.0 is the leading alcohol-free beer which is sold in more than 110 markets across the world.

Our recipe for innovation

Creating an alcohol-free beer but with the comparable taste, texture and complexity of alcoholic beer was no mean feat. It took the creativity and collaboration of our Master Brewers who worked across markets and our R&D department who utilised their foundational scientific knowledge about products and processes to come together to make this shared vision a reality. At the same time, we worked with leading universities and research institutes in the UK and the Netherlands to test concepts and fill any knowledge gaps.

Texture, flavour and complexity are all essential pillars defining the beer drinking experience. Building on insights from our consumers, and working with scientists, we conducted detailed analysis of taste and flavour compositions and learned about the sensory perception of consumers regarding their flavour needs for non-alcoholic beers. We then looked at how flavour components react in a non-alcoholic vs alcoholic beer context.

Once we had the winning formula in terms of recipe and taste, we looked at the technology around dealcoholisation and collaborated with our equipment suppliers to optimise the processes to ensure that they were scalable.

1 The Impact of Lower-Strength Alcohol Products on Alcohol Purchases by Spanish Households by Peter Anderson and Daša Kokole 2022

Bringing it home

The knowledge gained during the innovation process has been reapplied and built upon so that at the end of 2022 our zero alcohol beverages category had 289 zero alcohol products across 125 brands and spanning a variety of taste profiles (lager, flavoured beers, ciders).

Yet just having the right products wasn't enough to truly revolutionise the market. The final challenge was to break down the barriers to consumer uptake and to change perceptions and behaviours. For this we needed some out of the box thinking.

We worked with experts in behavioural science to look at changing consumer behaviour to empower consumers to reach for the alcohol-free options. By using the power of our platforms, like Formula 1 and Champions League, we made moderation and 0.0 'cool'. In 2022 we launched the – 'Cheers To No Alcohol' campaign – which addresses the feeling of exclusion that can be experienced when choosing not to drink alcohol at social occasions.

In the same year, we also went one step further with the roll-out of Heineken 0.0 on tap in pubs and bars. This again required a breakthrough by our scientists to solve the problem of alcohol formation in the keg. We also collaborated with the UK's leading soap operas to bring it to life in their fictional pubs which was another key step in normalising this choice.

Recommendations: Embracing all innovation

To build our innovation potential in Europe we need to fill two gaps. Firstly, innovation starts with creative people with an entrepreneurial spirit and the courage to aim high. The EU and national policymakers can promote this by ensuring our education and training systems encourage students to think outside of the box – helping them develop practical and theoretical knowledge and experience and offering opportunities to work with business on real-world challenges to develop these skills.

Secondly, we need to take a broader view of innovation and how we support it. Product innovations like Heineken 0.0 change lives and deliver societal benefits. Policy should also support and encourage investment in this kind of innovation. Innovation comes with a delicate balance of risks versus potential benefits, and instruments like innovations boxes and grant programs help to incentivise the necessary risk-taking that drives innovation.

Innovation doesn't stop with bringing the idea to life. It takes many forms – not just product and process but also changing mindsets, creating new markets, and communicating in new ways. EU innovation policy and R&D support programmes, combined with the right kind of tax incentives, can have an even bigger impact if they embrace innovation in the broadest sense. This includes providing opportunities for business and the scientific and research community to work together to ensure that innovations are successful outside of the lab.

Jan Jenisch
CEO
Holcim

HOLCIM

	Climate change, industrial decarbonization
	Process
✓	
✓	
	Reaching net zero targets
	Regulatory environment, absence of value chain, funding, cross sector cooperation
✓	With external partners
✓	Across several sectors
✓	Conditional on other factors
◆	

To net-zero with CCUS

The construction sector accounts for an estimated 38 % of global greenhouse gas emissions. It has an essential role to play to accelerate our world's transition to net-zero.

The journey to net-zero requires a holistic approach that ranges from adapting our own manufacturing operations all the way to accelerating the introduction of low carbon and circular solutions on the market to enable the low carbon shift across the entire construction value chain. In cement manufacturing, reaching net zero will require the deployment at scale of carbon capture and utilisation or storage (CCUS) technologies.

Carbon capture separates and concentrates CO2 from industrial processes. The CO2 can then be safely stored underground, recycled for applications such as fuels and chemicals, or permanently captured in concrete and other mineral components. The European Commission considers CCUS as one of the seven strategic pillars in their "A clean planet for all" strategy, and the IEA Roadmap for the cement sector projects CCUS being deployed at scale as of 2030.

The challenge around developing and deploying carbon capture projects at industrial scale is that it does not rest on a one-size-fits-all technology. The options for the utilisation and/or storage of CO2 vary enormously from one site to another, including in terms of the regulatory environment and project-specific situations. Moreover, all CCUS projects require cross-sectoral integration of different value chains, either to turn CO2 into a useful feedstock or to transport and store it geologically.

50 shades of CCUS

At Holcim we are committed to decarbonising our cement production, in line with our industry-first 2050 net-zero targets, and we believe that CCUS will be a key enabler. To this end, Holcim is testing the technical and economic feasibility of CCUS in more than fifty projects across Europe, North America and further afield in both Carbon Capture Storage (CCS) and Carbon Capture Utilisation (CCU)

In Europe, Holcim has recently been selected under the EU Innovation Fund for one CCU project in Germany (Carbon2Business) and one CCS project in Poland (Go4ECOPlanet). Through the Innovation Fund, the European Commission supports the large-scale deployment of highly innovative technologies in Europe.

Let's use Holcim's Carbon2Business CCU-project in Germany as an example. The project is fully integrated into the larger HySCALE100 project (a recognised IPCEI hydrogen project in Germany), a green hydrogen value chain integrated with e-methanol production. The Carbon2Business project aims at capturing over one million tons of CO2 through the deployment of a technology known as "oxyfuel", a process during which combustion air is substituted with pure oxygen resulting in a CO2-rich flue gas, which is dried, pressurised, and purified in a subsequent Carbon Processing Unit. In the case of the Carbon2Business project the pure oxygen will

be provided by a 2-Gigawatt green hydrogen electrolyser powered by offshore renewable energy, which produces excess oxygen that is recycled in the oxyfuel process.

The resulting green hydrogen and purified CO2 are combined to produce synthetic fuel for the aviation sector for which there is increasing demand regionally.

Carbon2Business is a first-of-its-kind implementation of the oxyfuel technology at a full industrial scale. And one that is fully integrated into a highly innovative regional green hydrogen value chain, born from a cross-industry partnership "Westküste 100" formed between EDF Germany, Holcim Germany, OGE, Ørsted, Raffinerie Heide, Stadtwerke Heide, thyssenkrupp Industrial Solutions and Thüga – together with the Region Heide development agency and the Westküste University of Applied Science.

Is the EU ready for CCUS?

CO2 can be stored permanently geologically or used in a wide variety of applications, ranging from agriculture to fuels or chemicals, with rapidly developing supply and demand value chains. Yet, whether the industry will be able to deploy large-scale innovative CCU projects depends largely on the existence of a coherent legislative frameworks for the full value chain.

We see ourselves at a crossroads on whether innovation in CCU technologies will remain economically feasible in the EU. This is largely the result of contradictory policy choices and a lack of clear direction on how to achieve the overarching goal of decarbonised industrial value chains.

The lack of coherence is blatant. CCU projects are eligible for funding under the EU Innovation Fund and are listed as part of the solutions under the EU Green Deal. And this is confirmed by a rapid growth in demand for CCU as a feedstock. And yet: at least two pieces of legislation are set to undermine the actual business case for industrial CO2 utilisation. A newly proposed 2036 shelf life for the use of industrial CO2 in the production of e-fuels is entirely at odds with the far longer economic cycle of such investments. Moreover, EU ETS rules, disincentivise the conversion of CO2 into an industrial feedstock, as the captured CO2 would still have to be reported as emitted to the atmosphere.

As for all ground-breaking innovation, policymakers should not lose sight of the bigger picture. It remains a fact that both carbon storage and use are needed to eventually reach carbon neutrality. The deployment of CCUS technologies will support the production of alternative e-fuels (via recycled CO2 and renewable hydrogen) – and reduce our dependence on fossil resources.

And let us think further ahead. Today we debate using recycled industrial CO2. But if we invest in this and scale it, tomorrow we can build on this and capture atmospheric or biogenic CO2. Innovation is a gradual process – it evolves one step at a time – unless there are too many regulatory stumbling blocks.

Hilde Merete Aasheim
President & CEO
Norsk Hydro

Hydro

- Sustainable mobility / Critical raw materials
- Product and manufacturing process
- ✓ Applied for EU Innovation Fund and IPCEI
- ✓ Innovation applies to batteries, which can be utilized across sectors, e.g., mobility, ESS
- Localized, sustainable production
- Technology Market access
- ✓ Close collaboration with cell manufacturers, partners as well as academia.
- ✓ Across sectors
- ✓ Conditional on other factors
- ✓

A giant leap to sustainable electrification

According to the International Energy Agency, the transportation sector was responsible for 37% of CO2 emissions from end-use sectors in 2021. To fulfil the EU's commitment to become the first zero emission continent by 2050, green mobility transition is an important lever.

By 2030, the European Union aims to have at least 30 million electric vehicles (EVs) on its roads. Yet, this is not a given – Europe will likely face significant shortages of several raw materials that are key inputs for electric vehicle battery production.

One of the materials needed in large quantities for battery production is graphite, today's leading material for the negative electrode of a battery, the anode. Graphite makes up about 15 percent of the weight of a lithium-ion battery, which for a medium-sized EV translates into 50-70kg of graphite. With these quantities in play, securing sufficient material supply is a challenge.

In addition, the carbon emissions of both supply chains and production processes are concerning. Battery materials are typically produced in Asia – by an energy intensive industry that largely relies on coal-powered electricity. About 85% of production capacity for anode materials is located in China.

Today, synthetic graphite production creates significant environmental issues. But this can change. If we manage to improve processes, synthetic graphite has the potential to become the most sustainable battery anode material available for all environmental impact categories. And in contrast to mined battery materials, it has minimal conflict potential.

New company, one purpose

Vianode, a Norwegian company owned by Hydro, Elkem and Altor, set out to produce sustainable synthetic graphite. The company's industrial pilot plant in Kristiansand, Norway has been operational since April 2021 – a first step towards building industrial leadership in advanced battery materials – and to bringing us closer to fast, sustainable electrification.

Although the battery value chain is considered young in Europe, Vianode can draw on a long industrial history. Both Elkem and Hydro have more than 100 years' experience in large-scale manufacturing of advanced materials.

Vianode itself has roots in Elkem's Carbon Division. The first blueprints were drawn in 2016 as an R&D initiative, leading to the establishment of a separate unit and later Vianode. Backed by the two industrial innovators, and entrepreneurs from Altor, a Swedish private equity fund, Vianode can safely label itself as a scale-up with legacy.

Solution for wider challenges | Type of innovation | Part of an EU / national initiative | Cross-sectoral innovation | Trigger

A sustainable battery industry

Vianode's synthetic graphite can be obtained by graphitisation of carbon sources, mainly coke, at high temperatures, resulting in a final pure product. Synthetic graphite is today the most common anode material and enables increased range, faster charging, long service life and recyclability and increased safety in EVs. All features support faster EV adoption and enable a well-functioning second-hand market for batteries.

Vianode has developed a revolutionary technology for the graphitisation process. Combined with closed and cleaner processing and renewable electricity from hydro-power this innovative technology helps reduce CO2 emissions by more than 90% compared to conventional production. While most current synthetic graphite anodes have a footprint of above 20kg. CO2 equivalents per kg. Vianode's anodes have an estimated footprint approximately ten times lower – below 2 kg. CO2 equivalents per kg. For that reason, Vianode's anodes are a key input to European cell manufacturers with ambitious sustainability targets. The efficient technologies and production process also contribute to reduced raw materials consumption.

This leap is made possible by specialised and proprietary expertise in high temperature and closed production processing systems. The closed furnace technology reduces energy consumption by up to 50% in the graphitisation part of production, compared to conventional production. Furthermore, reduced energy consumption helps minimise other direct emissions.

Sustainability and the green transition are also key themes for Vianode's input materials. By using coke, we are converting a by-product from fossil energy production into an enabler for new green industries. In the future we will also enable circularity, as our R&D on the recycling of anode graphite yields promising results. We are prepared for full circularity once the battery recycling industry matures.

Vianode has already decided to invest NOK 2 billion in an industrial scale plant. Towards 2030, the company will invest in more capacity, and aims to produce synthetic graphite materials for 2 million EVs per year.

The scale-up challenge

We have mastered the technical challenges – and we have a strong business case: Vianode's innovation has the potential to enable a sustainable European battery value-chain and reduce Europe's dependence on imports from third countries.

And yet we have not surmounted all hurdles for scale-up. Why is that?

First, funding remains a challenge. Vianode's owners are committed to investing into the scale-up of production, but the project can be de-risked and built more quickly if supported by EU funding – for example by the EU Innovation Fund and or as part of an IPCEI. Yet in both cases, the application processes are slow with an uncertain outcome. A simpler and more streamlined process with clear conditions for grants, would speed up the process and make future-planning easier.

Second, the Critical Raw Materials Act could be a gamechanger for a European battery value chain. Natural graphite is already listed as a critical raw material. By recognising synthetic graphite as interchangeable with natural graphite, the EU would strengthen its opportunity to sustainable source critical battery materials.

One innovation lesson is that when a breakthrough materialises, we should grasp it and nurture it. If it ticks all the boxes, let's create the right conditions for maximum impact.

Ignacio S. Galán
Executive Chairman
Iberdrola

IBERDROLA

Climate change

Product & process

Customer demand, fighting climate change

Funding, regulatory environment, lack of skilled workforce

External partners (research institutes/academia, start-ups, large companies...)

Across industry, transport, etc

Depending on cross-sectoral demand, public funding

Public funding needed to boost green hydrogen generation

A new vector for a decarbonised Europe

The electrification of the economy – of transport, heat and industry – is a huge challenge and a massive opportunity. It involves the wide scale deployment of renewables, grids and energy storage – all of which are essential if the EU is to make a success of energy transition. Accelerating Europe's energy transition is not only necessary to mitigate the climate crisis, but will also play a key role in improving energy security and the competitiveness of our industries. Moreover, it will help create sustainable jobs throughout the value chain.

However, not all sectors are easy to electrify. For technological reasons, this is particularly difficult for energy-intensive industry and heavy transport. Here one solution lies in using hydrogen.

Currently, the majority of hydrogen production worldwide is based on the steam methane reforming process (75%) and on coal gasification (25%), in both cases emitting CO2 (approximately 10 kg of CO2/ kg of H2 produced) and requiring significant amounts of primary energy.

We at Iberdrola believe that we can do better than that. In fact, for us the answer is green hydrogen that is produced using renewable electricity. If this becomes common practice, and as the International Energy Agency points out, this would save 830 million tonnes of CO2 per year as compared to when this gas is produced by fossil fuels. Those savings are equivalent to the emissions of a country like Germany.

Greening hydrogen

Obtaining hydrogen by electrolysis of water from renewable energies is not only feasible, but relatively easy to achieve, due to the abundance of water in nature and the unlimited capacity of renewable energies.

To make this a reality in Europe, Iberdrola is now pioneering the largest green hydrogen plant for industrial use in Europe, located in Puertollano, Spain, with an investment of EUR 150 million. This innovative initiative will create up to 1,000 jobs and avoid emissions of 48,000 tCO2/year.

The plant consists of a 100 MW solar photovoltaic plant, a lithium-ion battery system of 20 MWh and one of the largest electrolisers in the world (20 MW). The solar plant features several technological innovations:

First, bifacial panels allow for higher production by having two light-sensitive surfaces and provide a longer lifetime. Second, cluster inverters improve yields and allow greater use of the surface area. Third, an energy storage system makes the plant more manageable, as the battery system (with a power of 5 MW) has a storage capacity of 20 MWh.

Iberdrola is also driving the green hydrogen value chain with this project. Thus, one of the main successes of this project has been the strong collaboration between 60 partner companies and institutions throughout the value chain, including research institutes/ academia, start-ups, large companies...

internally, our innovation team brought together the renewables business and the green hydrogen unit, which was recently created at Iberdrola.

Our plant is part of an ecosystem with a larger innovation mission: Europe's first large-scale experiment in green ammonia generation. We will produce green hydrogen for Fertiberia's ammonia factory in Puertollano, one of the EU's most efficient ammonia factories – with a production capacity of more than 200,000 t/year. As a result, the plant's natural gas needs will be reduced by more than 10%.

In the future, the waste heat produced as a result of the electrolysis process could be used to provide hot water and residential heating to the town of Puertollano through a heat network that Iberdrola is already promoting in the town.

An important milestone was reached when the project was recognised as an Important Project of Common European Interest (IPCEI).

Our next project, for which we have been awarded a ten-year contract, is to build and operate a green hydrogen plant to fuel buses be used by Transports Metropolitans de Barcelona (TMB) buses and other fleets and industries.

All in all, Iberdrola already has more than 60 green hydrogen projects in its portfolio in eight countries, including Spain, the United Kingdom, Brazil and the United States. We are responding to the electrification and decarbonisation needs of sectors such as industry (steel, ammonia and methanol) and heavy transport (aviation, trucks, etc.).

Where policymakers can make a difference

As you can see, industry is ambitious to play its part in the green transition. But we need a supportive environment for innovation to bear fruit.

To carry out projects without loss of time, policymakers should take the following measures: adoption of a definition of renewable hydrogen; simplification and homogenisation of administrative procedures; speeding up permitting for renewables and also for renewable hydrogen installations; and adoption of the most ambitious binding targets for boosting renewable hydrogen and fuel derivatives in hard-to-electrify industry and transport.

To promote the development of the technology and roll it out across the EU, public incentives, both economic and regulatory, are key to supporting projects that respond to a real demand and with immediate industrial application (production of ammonia, green methanol, replacing fossil fuels in high temperature process...), ensuring fast and simplified access to support and financing instruments.

To scale up spread of the technology across Europe we need a skilled workforce, i.e. professionals trained and qualified in this technological area.

The US Inflation Reduction Act shows that, with political will, the right incentives for innovation and scale-up can be set. And that there are clear lessons for Europe if we want to remain leaders in green innovation.

Jacob Wallenberg
Chair
Investor AB

investor

	Funding, allowing European basic research to become industrially relevant
	Between universities, venture capital and industry
✓	
✓	
✓	Between universities, venture capital and industry
✓	Relevant to many large corporations
✓	Conditional on government support
✓	(Incremental innovation), but: 'reed downwards tick'. (new, science driven opportunities)

Revolutionising the deep tech transfer

Europe performs well on leveraging and improving existing technology – 7 of the top 10 countries in the Bloomberg Innovation Index 2021 are European. However, we excel mainly in incremental innovation, exploiting existing technology platforms. We are lagging when it comes to bringing disruptive technologies to market.

Such technologies are often labelled "deep tech" – innovations founded on scientific discoveries or tangible engineering innovations. Deep tech is the basis for most new industrial technologies and a necessary element in addressing current societal and environmental challenges. They are also core in navigating the extraordinarily volatile industrial environment.

The economic case for deep tech is strong – and yet in Europe, private funding for deep tech is weak. Capital markets have since the ICT boom optimised to finance software companies – and steered away from deep tech and its perceived risks and long lead-times. Also, university research often stops long before a research result is mature enough to be the base for commercially-oriented innovation.

Europe's relative inertia on the financing side holds back the industrialisation of research- and high-tech based innovation. More problematically, it does so in a time of turbulence in the global technology landscape, where we a) see the end of life of many of the legacy technologies that form the backbone of large industries and b) face increased pressure of sustainable transformation of industries, energy systems, transportation, etcetera. Moreover, geopolitical turbulence counteracts knowledge-sharing and cooperation, with two superpowers in a race for leadership on semiconductors, quantum computers and AI systems – and Europe unable to match their pace.

Funding the science-to-industry innovation transfer

Science underpins the future competitiveness of any industry – yet in Europe we still struggle with the transfer of new science to industry. The Wallenberg Foundations set out to form a coherent tech transfer system, complementary to publicly-funded tech transfer.

The Wallenberg Foundations fund basic research and strategic research programmes aimed at e.g. autonomous systems, AI, quantum technology, sustainable materials and the digitisation of life science. The Foundations also support laboratories and other facilities enabling cross-disciplinary research (such as Swedish SciLifeLab, that makes unique technologies and expertise available to scientists in different areas of life science).

Lately, the Wallenberg Foundations have introduced a proof-of-concept grants programme called WALP – the Wallenberg Launch Pad. Research groups can apply for grants to investigate the minimum viable product and commercial feasibility of their research results. Such soft funding for pre-commercial verification of research is an

important prerequisite for attracting private investments in the prospective spin-out companies.

In addition, the asset management arm of the Wallenberg Foundations has initiated an in-house venture firm to provide seed- and early-stage funding of university spinouts. The venture firm invests in companies on commercial terms but can support companies long-term, not as a closed-end time limited venture capital fund. The firm focuses on research funded by the Wallenberg foundations and aims to "crowd in" additional private capital by positioning itself as an early stage and leading investor in deep tech.

We believe that a region's access to long term capital and ownership for highly innovative firms is core to industrial competitiveness. More than that, it is a central mechanism to protect strategically important capabilities. Thus, Investor – with the Wallenberg Foundations as its largest shareholder – as well as other industrial groups with the capacity to foster and grow spinouts, become important to the innovative industrial ecosystem.

How to unlock Europe's deep tech potential

The European Innovation Agenda of July 2022 acknowledges the importance of Europe's world-class position research and deep and disruptive technologies. However, it does not adequately address the lack of efficient mechanisms for tech transfer, crippling our potential. To come to terms with this, I see the need for the following actions:

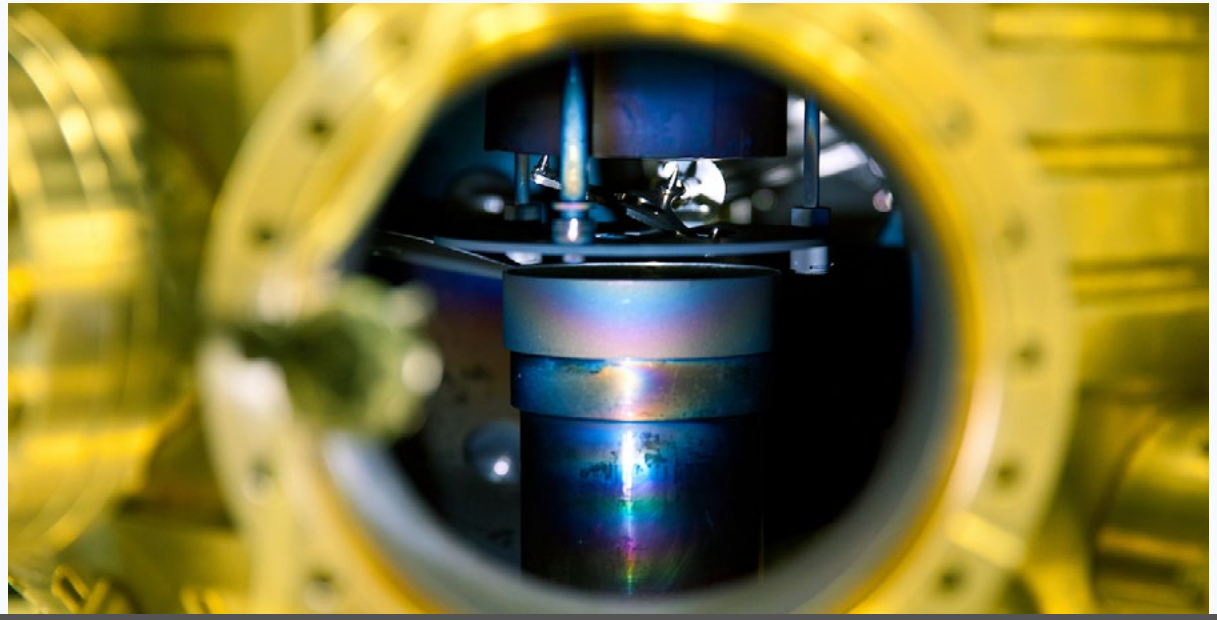
First, we need to urgently find better ways of packaging basic research results into useful innovation platforms, typically as deep tech start-up companies. The excellent European basic research needs to be supplemented by equally excellent applied research that produces commercially relevant, industry-ready results. Regulatory obstacles, such as abstract worries about state subsidies, often lead to research being halted before results are tangible enough to involve private actors. Yet, we are competing with a strong, federally-funded institute sector in the US, aimed at converting basic to applied science directly applicable to industrial challenges.

Second, long-term steering of research, funding of relevant start-ups and directing innovation procurement requires deep understanding of long-term trends in science and industrial dynamics. We lack agencies that define and manage strategic projects (like DARPA, NIST, etc) and set the direction for joint efforts.

Third, we need to strengthen funding for the establishment and growth of deep tech start-up companies. The EIC fund is an excellent initiative at European level, but we need to improve the local environments close to the European universities. Solutions would be blended financing combining grant and equity, more deep-tech funds, cooperation with CVC funds, as well as commercially savvy tech transfer offices at major universities.

Fourth, industry should invest more in their interface with academia and the deep tech ecosystem. Such interface will be synergistic – stimulating learning and collective action.

We have all the elements in place – research universities, large global industries and an entrepreneurial landscape as never before. We just need confidence and boldness to put these together into an ecosystem that will make us define the industries of tomorrow.



Ilham Kadri
CEO
Solvay

Alessandro Profumo
CEO
Leonardo

	Circularity
	Product, process, innovative partnership
✕	
✓	
	Market trend, sustainability mindset
	Technology challenges, funding, permitting, regulatory environment
✓	External partners
✓	Across several sectors
✓	Conditional on other factors
👍	

Gravitas to the lightweight

The future of air transport is being rewritten. We all know that a new chapter is about to start for energy sources, but the story is much richer than that. The design and development of next generation aerospace technology comes with its own sustainability and innovation challenges.

Developing new strategies, materials and manufacturing processes to limit greenhouse gas and pollutant emissions – without compromising aircraft performance and quality – has become fundamental. One of the main difficulties for the aerospace industry is to make the materials used for large and complex structures – usually Carbon Fibre Reinforced Polymers (CFRP) and metals – more sustainable.

One challenge is to reduce the weight of aerospace components without affecting the safety of the system. If successful, the design and development of lightweight structures would allow reduced fuel consumption and, consequently, lower CO2 and greenhouse gas emissions. Moreover we could implement the circular economy paradigm for raw materials used in aeronautics, such as CFRP.

The magnitude and technological complexity of this task are daunting. It requires not only an extremely advanced technical know-how – rarely available to one company alone – but also a systematic approach.

Joining forces across aerospace and chemistry

Leonardo and Solvay created the Joint Lab, an innovative partnership between two leading companies active in different sectors – aerospace and chemicals/materials respectively. The Joint Lab brings together complementary skills and expertise to spearhead advanced research in the field of advanced composite materials and production processes applicable to the aerospace sector. Kick-started in February 2021, the Leonardo-Solvay Joint Lab draws on Leonardo's Lab in Grottaglie (Taranto) and Solvay's MSAC – the Material Science Application Centre in Brussels.

One of the Joint Lab's main work-streams is the innovative technology of thermoplastic 'engineered materials' and, in particular, the welding and automatic lamination ('in-situ' consolidation) of complex and large aerospace structures. Compared to the analogous process with thermoset composites – already used in large scale aircraft projects such as the Boeing 787 and Airbus220 – our new thermoplastic technology will bring several advantages.

First, large structures can be produced with an automatic lay-up that no longer requires any post-process. Second, thanks to welding and overmoulding the parts assembly of thermoplastic composites is simpler, allowing for more fuel-efficient aircraft – lowering fuel consumption by 15 % and gas emissions by 20 %. Third, shelf-life is practically infinite at ambient temperature – energy intensive freezer storage, as required for thermoset materials, will be a thing of the past. Last but not least, thermoplastic composites can be fully recycled with a straightforward, mechanical, process into injection mouldable compounds. In short, thermoplastic composites will be a game

changer in aircraft construction and make this industry more circular.

However, to bring the thermoplastic composite technology to the required maturity level we still need to close very big technical gaps. We are pooling our complementary competences to increase the chance of success.

Other work streams of the Joint Lab include the improvement of existing composite materials to be utilised for extreme conditions and advanced lightweight applications. Moreover we are together developing new manufacturing processes starting from early stage technologies and are working on the promotion of circular economy practices (fibres from CFRP scraps are recycled in to new high performance composites). Looking forward, the Joint Lab enables our companies to collaborate on new commercial initiatives.

Conditions for success

A key factor for the Joint Lab's success is its governance, based on a flexible structure, which gives the team a great degree of autonomy and the chance to set up its own rules of operation. This facilitates communication between researchers and makes collaboration easier and more efficient.

As our competencies are strongly complementary, we have defined clear responsibilities. The Leonardo team is responsible for the identification of areas in which the recycled materials should be integrated. This involves designing parts, developing eligible materials, analysing composite recycling parameters and the final fibre characteristics, as well as developing industrial solutions, and providing materials engineering expertise. The Solvay team, on the other hand, provides materials science expertise, compounding and injection moulding capabilities and industrial processing of composite materials to give new life to materials and create secondary raw material for different applications.

In addition, the Joint Lab is based on an 'open innovation' paradigm, allowing both companies to leverage not only on each other's internal infrastructures, but also on their collaboration with institutions, research centres and universities, in Italy and abroad.

Our ask from policymakers

We are convinced that this partnership will lay the foundation for further collaboration in aerospace and beyond, enhancing innovation speed and efficiency.

That said, we could be operating under better conditions. Both our innovation model and our research area should be supported by adequate public innovation support mechanisms.

Moreover, the regulatory framework falls short of giving perspective on two fronts.

First, coherence between political goals and actual sector specific regulation is critical in highly regulated markets, such as aerospace, considering that the employment of recycled materials is still in its early stage. Now is the time for EU and international aerospace regulatory agencies, as well as standardisation bodies, to start exploring ways to include recycled materials into the existing regulatory frameworks and to involve industrial stakeholders in this effort. Second, a coherent EU regulation framework would also facilitate the circularity of such evolving materials.

We would strongly encourage regulators to launch a collaborative and innovation-driven review process of existing regulations. If this is done right, it would allow the Joint Lab's model to spread across different industrial ecosystems. The advantages are obvious: a hard-to-match cross-fertilisation of expertise that results in greater sustainability, technological leadership and future competitiveness.

Jean-Paul Agon
Chairman
L'Oréal

L'ORÉAL

Climate change, resource scarcity (water)

Product

Contact with start-up

Converting prototype to product outside our core business

With the start-up behind the original concept

Less is more

Water scarcity has become an urgent environmental issue and will become even more urgent as the consequences of climate change manifest themselves further. At L'Oréal we believe that water is a precious resource and should not be wasted and that this concern is becoming ever more critical.

This belief is one of the drivers of our global sustainability strategy L'Oréal for the Future. We have spent the last ten years driving an in-depth sustainability transformation across our activities, operations, research and products design, in order to reduce the environmental impacts across the entire lifecycle of our products.

The water challenge

How to reduce the ecological footprint of personal hygiene? Across the full lifecycle of haircare products, the use by consumers (i.e. showering and rinsing) represents 73% of water consumed and 83% of the CO2 emissions. Significantly reducing the water usage for showering and rinsing would have a huge impact on the sustainability of personal hygiene – far beyond the L'Oréal product range.

We have made a big step towards this goal by developing a sustainable and innovative shower system with the highest water and energy efficiency: the L'Oréal Water Saver. By partnering with Gjosa – a Swiss start-up created in 2016 – we have developed a technology for hair-care salons that reduces the water and energy consumption of hair washing by up to 65% as compared to conventional systems, and yet delivers a similar experience to customers. While a classic showerhead delivers about 12 liters of water per minute, Water Saver can limit it to less than 7 liters.

The technology behind it makes use of kinetic energy (being a function of mass and velocity). Our showerhead is designed to favor speed over mass. The technology consists of highly precise water collisions, creating micro-drops at increased speeds. The water-drops are fragmented and become finer and propelled at high speed, at 40-50 km/h that means fewer but stronger water drops. TIME listed this amongst the Best Inventions 2021.

Recognising and seizing opportunities

Paving the way to disruptive solutions allows us to anticipate our consumers' changing demands. Over the last years we had reshaped L'Oréal's Research & Innovation organisation and resources, to allow us to better detect, select and transform external technologies & innovation opportunities into successes. Our R&I teams seek out innovations that can overcome the technical design barriers intrinsic in beauty products & services, in a mode of push and pull, whilst anticipating how beauty expectations and practices will evolve in the future. This is supported by BOLD, L'Oréal's venture capital fund, whose purpose is to pursue minority investments in promising startups across the beauty value chain.

Our team had already identified Gjosa was one of the deep-tech start-ups we could partner with, but the innovation potential of its Water Saver Solution was detected while working on a different topic with Creaholic, an "innovation factory" made up of a team of experts across a wide range of industries, focused on new solutions and new areas of growth.

The disruptive innovation team who had scouted Gjosa were then followed by L'Oréal Research & Innovation's Open Innovation Team who continued to mine the concept and also structured the collaboration with the start-up. As a rule, L'Oréal always tries to pair a start-up with the internal team that has the most relevant experience and expertise. Once there was a proof-of-concept with Gjosa, it remained difficult to convert the technology in a product application. L'Oréal's Augmented Beauty team (specialised in tech and in converting proof of concept into market launches) stepped in, providing more business support, and worked with Gjosa to develop a product that could go-to-market.

All L'Oréal teams working with Gjosa shared the same philosophy. Rather than establishing a client-supplier relationship with Gjosa, they cultivated a mutually beneficial, collaborative and partnership-style approach: Gjosa shared the theory behind its water technology and L'Oréal brought to the table its market knowledge, marketing and communication inputs. L'Oréal decided to acquire a 15% minority stake in Gjosa SA, via its BOLD fund.

The L'Oréal Water Saver was piloted in hundreds of hairdressing salons, undergoing a few iterations. It was launched in late 2022 by the L'Oréal hair-salon brand, L'Oréal Professionnel. It will be sold exclusively to hair salons. Thanks to the combination of the Gjosa technology and L'Oréal state-of-the-art haircare formulas, the Group will continue to develop this strong co-innovation in the months and years ahead.

What we've learned

Although Water Saver is living up to its promise, the process of converting the prototype into a product was quite a learning curve for both the teams of L'Oréal and Gjosa. The learnings will serve L'Oréal for its future innovation work-streams: We learned to look outside our core business and be open to new innovation avenues and future business opportunities. Showerheads is not one of our lines of business, so we needed to take the time to acquire a better understanding of the market and how to market these types of products. It's about speaking the same language as our partners. When working with deep tech start-ups, we involve a team with a strong tech background rather than one in the beauty industry. We share time with the start-up in a joint lab.

As a message to policymakers: in our case prototype testing was a key factor to success, and it was crucial that we could do this under market-like conditions. This is an area where policymakers could open up possibilities to make Europe more innovation friendly.

MAERSK

Climate change

Scaleable carbon-neutral transport

Internal process

Creating entire ecosystem from scratch

Suppliers, regulatory bodies

Innovation can be used for other applications

International Maritime Organisation /international legislation is too slow

All hands on deck – bringing shipping to net-zero

Ocean shipping is indispensable to global trade, with nearly 90% of goods moving across the seas. International shipping accounts for 3% of all CO2 emissions. Reducing – and as soon as possible eliminating – these emissions is a priority for our industry. In 2021 Maersk's direct (scope 1) CO2eq emissions amounted to 34 million tons. To reduce CO2 emissions and offer green transportation to customers, Maersk uses biodiesel and other drop-in biofuels in the fleet. However, these fuels are in short supply and not scalable.

We must innovate to find a solution. And we can do so also thanks to many of our customers who today are buying green shipping with the Maersk ECO Delivery product and who are keen to advance the green transition by creating a demand for green shipping.

Setting sail for the first carbon-neutral container vessels

How can we build and launch the first carbon-neutral container vessels? This question has been the focus of our innovation work over recent years. Working together with partners across the maritime ecosystem and beyond, from engine builders, fuel suppliers, equipment manufacturers, and classification societies to infrastructure developers, Maersk has analysed several fuel and technology options.

We identified green methanol as a solution where technology is ready and fuel production can be scaled up to have a significant impact before 2030. Until now, methanol as fuel for vessels had been used only for a few minor methanol carriers and other niches. The innovation work spans the entire value chain: from fuel supply development and sourcing to the infrastructure for transportation and storage at ports, as well as developing and building the first ocean-going container vessels that operate on green methanol.

This success was made possible by our coalition of partners' achievement to develop first-of-a-kind projects to scale up green methanol production. This excellent collaboration between European companies helped reduce the technical risks for the methanol vessels and accelerated the innovation work.

The situation around green methanol vessels and production was a classic chicken-and-egg situation. Fuel project developers/producers needed guaranteed offtake to develop and finance production facilities, while shipowners need visibility and certainty of green fuel supply before ordering vessels. To break the stalemate, Maersk has ordered 19 green methanol vessels despite the green fuel (still) not being available in the amounts that these vessels will require. Given the projected higher cost of fuel, the vessels are designed for energy efficiency and prepared for future technologies like fuel cells.

Once all vessels are in operation, total methanol consumption will amount to about 0.75 million tons/year. By creating a certain demand for green methanol on the market, Maersk has been able to develop offtake partnerships with seven companies for projects globally. We also start to see traction as other shipping companies order methanol vessels, increasing demand for green methanol.

Big implications – and opportunities – ahead for our value chain

Another area of innovation is the methanol infrastructure for supplying fuel to the vessels. While some infrastructure for trading methanol as chemicals exists, global use of green methanol as fuel requires storage and supply infrastructure. We are in dialogue with major container ports to drive this forward. Here green corridor initiatives will play a central role.

Looking forward, electrolysers and fuel cells can become a golden opportunity for Europe. Much of the technology for green methanol that will see a massive upscaling is being developed by European companies. The fuel cell technology has the potential to unlock efficiency improvements of up to 50% compared to traditional engines, which will be a crucial improvement. Green fuel projects placing orders for electrolysers will generate a massive build-out of production facilities and supply chains to meet the demands of the market. In combination, these technologies represent the next tier of technology with the potential to act as a catalyst for the green transition. By seizing this opportunity, we can create valuable jobs and economic activity across Europe and deliver on the green transition.

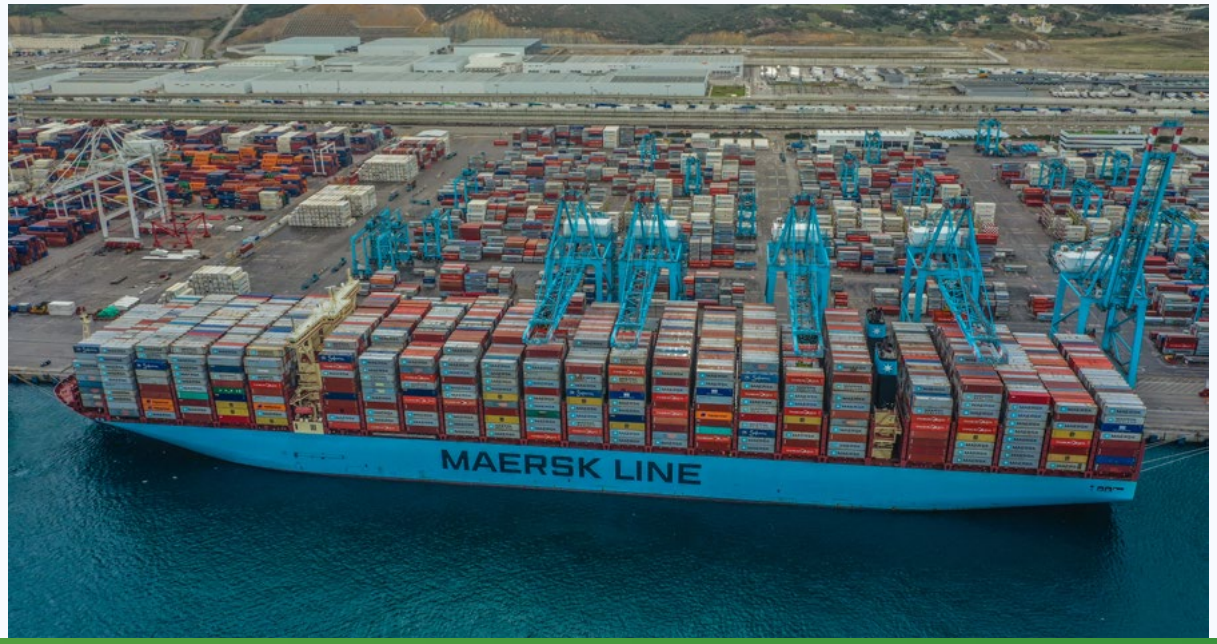
Regulatory headwinds

We face several challenges in our innovation work, both when it comes to fuel sourcing and signing actual contracts:

Firstly, regulatory uncertainty discourages innovation. Project developers need bankable offtake agreements to make green fuel projects reality. However, the key provisions on the treatment of green fuels in EU legislation are incomplete which creates regulatory uncertainty. This concerns particularly the inclusion of shipping into the Emissions Trading System (ETS) and the delegated acts of the Renewable Energy Directive (RED) on Renewable Fuels of Non-Biological Origin. The uncertainty creates a regulatory risk for one or both parties.

Secondly, current permitting timelines can be very long because fuel projects are a new concept. Such delays are an additional obstacle to getting the first large-scale fuel projects off the ground.

Thirdly, the competitiveness gap between fossil and green fuels does not work in our favour. Fossil fuels are currently cheaper than green methanol (and other green fuels). The vast majority of green fuel projects need support to close the cost gap between green and fossil fuel options. Policy measures can help close the competitiveness gap by incentivising production and encouraging large-scale projects (see the US Inflation Reduction Act as a recent example). While we welcome the Act, as a European company we are concerned that – without any public sector efforts in Europe – green fuel projects in Europe will no longer be viable and that Europe will lose out on jobs and investments that the green transition can create.



Florent Menegaux
CEO
Michelin

MICHELIN
A BETTER WAY FORWARD

Circularity	
Process	
✓	
✓	
Company-set target	
Cross-sector cooperation / end of life criteria	
✓	With external partners
✓	In the rubber sector
?	The EU needs to harmonise 'end of waste status' for tyres
👍	But need regulation facilitating innovation in circularity

Not only round but circular too

When you are on a bike, car, a bus, an airplane as it lands, the only point of contact with the road is the tyre. The tyre makes it easier for you to move around comfortably and safely and can help reduce the energy needed to move forward.

Today, after being used on vehicles, around half of end-of-life tyres in Europe are then exported to third countries. Clearly, this approach is neither desirable nor sustainable.

At Michelin, our vision of a circular economy is divided into four parts: Reduce, Reuse, Recycle and Renew. To reduce the use of tyres, we are providing long lasting performance tyres which contribute to the reduction of CO2 emissions. We also repair, regroove, or replace the tread of tyres to give a second and even multiple lives to tyres. To further advance recycling, we invest in R&D to find innovative and more efficient recovery solutions so that the material in our tyres ultimately find its way into new products such as roads or sources of energy. To renew, because raw materials are finite and therefore precious, we take a sustainable approach to tyre design from the very beginning.

Circular tyres

Today, a quarter of the raw materials we use are renewable. We are now working on integrating materials coming from end-of life tyres and to form a virtuous cycle. To do so, we need to develop technologies which allow us to extract secondary raw materials from end-of-life-tyres. In a product like tyres, this is more complex than it sounds and thus demands exploration across the entire ecosystem.

Michelin is a highly committed partner in the Horizon 2020 BlackCycle project – to design world-first processes to make new tyres from end-of-life tyres. Known technologies in this domain are limited and the BlackCycle project will have to deliver new technical raw materials relevant for tyre production or other technical products. It will proactively integrate these new secondary raw materials and verify the progress on environmental performance.

Creating a new value chain

The first objective of the BlackCycle project is to accelerate innovation and development around secondary raw materials from end-of-life tyres by bringing together all the stakeholders from the start. Secondly, the BlackCycle project aims to create, develop, and optimise a full value chain, from end-of-life-tyres feedstock to secondary raw materials, eliminating waste of resources in all parts of the chain and paying specific attention to the environmental impact.

The BlackCycle project benefits from Horizon 2020 funding up to nearly €12 million out of an overall budget of nearly €16 million. It brings together 13 partners from companies to academia from five countries, with four being EU Member States.

With the end of project currently foreseen for August 2023, partners expect to validate the overall process of sustainable secondary raw materials production derived from end-of-life tyres and the quality of the products. The ultimate objective is ambitious: to establish a high-quality and competitive end-of-life-tyre

management and transformation industry within the EU. In fact we expect that one out of two of all European end-of-life tyres will be incorporated into the new circular value chain.

BlackCycle – already a success

In December 2022, Black Cycle announced the production of several tons of the first sustainable Carbon Black from end-of-life tyres and its successful introduction in a Bus Tyre. A major technological breakthrough was made possible by the BlackCycle value chain driven by the stakeholders of the project.

Because, the carbon black content of elastomeric materials is relatively high, the technology applying pyrolysis oil as feedstock for CB production is a major leap towards a more sustainable rubber industry.

From an environmental and consumer perspective, BlackCycle will lead to major improvements. Consumers will be able to access greener alternatives with a much lower environmental footprint thanks to the circular use of resources such as fossil materials or rubber. Globally, substantially lower exports of end-of-life tyres from Europe mean less emissions from shipments and less environmental challenges abroad.

A recipe for the circular economy?

The BlackCycle project is a very encouraging example of what can be achieved under the Horizon framework. By involving academia and the entire value chain and thinking outside the box, we have created a blueprint for other sectors which struggle with recycling and even upcycling of end-of-life products.

However, current EU legislation on waste is a true barrier to tyre circular economy. The generation, transport and use of our secondary raw material remains precarious under the existing EU rules on waste and the end of waste status – which do not support the deployment of a circular economy. To reap the benefits of BlackCycle and strengthen the basis for further investment and innovation, our industry urgently needs a harmonised regulatory framework for the end-of-waste status criteria for end-of-life tyres.

Today's push for zero-emission mobility also ups the challenges for tyre-makers as it is putting even more strain on the tyres. We are waiting for the European Commission to propose dedicated calls for innovation for developing new tyres ready to meet the challenges raised by the decarbonisation of transport.

Mark Schneider
CEO
Nestlé

Nestlé

	Climate change, environmental impact of agriculture, food security
	Product
✕	
✕	
	Company set ambition, EU strategy
	Scientific challenges, commercialisation hurdles (lack of harmonisation and level playing field)
✕	Strong internal collaboration
✕	
✓	

Food for thought

Why our food system needs innovation

Our current food system urgently needs to transform to address today's critical environmental, health and social challenges – climate change, land degradation, water stress, loss of biodiversity, farmers livelihoods, over and undernutrition including access to affordable nutrition. The COVID-19 pandemic put a spotlight on the importance of robust and resilient food systems, which the war in Ukraine and its effects only confirmed.

In the EU's Farm to Fork strategy, plant-based foods are highlighted for the important role they can play in addressing the environmental impact of the food system as well as the health needs for specific consumers while contributing to animal welfare.

More plant-based options

Nestlé is about good food, good life. Good food that is nutritious and tastes great. Good food that also respects our planet. We play a key role in helping consumers on their journey towards more sustainable and healthy diets. This is why we continue to expand our offering of plant-based foods and beverages.

Innovation is a critical enabler of our food system transformation journey. Globally, around 300 Nestlé R&D scientists, engineers and product developers dedicate their work to the research and development of plant-based products, representing almost 10% of all our R&D employees. To complement our internal capabilities, the company also collaborates with academia, suppliers, start-ups and various other innovation partners. Our scientists also work with farmers to breed and select nutritious, tasty pulses and grains best suited for plant-based alternatives.

Our R&D capabilities enable us to deliver innovations quickly and scale them up across brands, product categories and geographies. Fast innovation is a priority. Nestlé's global R+D Accelerator program provides start-ups, students and Nestlé scientists with a unique platform to explore new ideas through a six-month test-and-learn approach. By tapping into the company's expertise in food science, safety, regulatory affairs and packaging, novel products can be rapidly tested in real market conditions. Today, Nestlé's global R&D Accelerator network consists of 14 sites in 9 different countries. Since 2019, more than 300 participants have benefitted from the programme and 150 products have been pilot-tested in 20 countries.

Since the launch of our own 100% plant-based burger (Sensational Burger) in 2019, Nestlé has expanded into a wide variety of plant-based alternatives, such as Vuna (2020), a tuna alternative, and vEGGie (2021), an egg alternative. We are giving people options with alternatives for dairy products, coffee mixes and creamers, and even chocolate has a plant-based variety through one of Nestlé's most iconic brands – KitKat V (2022).

Solution for wider challenges · Type of innovation · Part of an EU / national initiative · Cross-sectoral innovation · Trigger

From theory to (policy) action

The EU Green Deal and the Farm to Fork strategy give a clear direction to transform Europe into the first climate-neutral continent by 2050, supported by consumer and society demand for plant-based solutions. But this ambition is undermined by a legislative landscape that has clearly not kept pace.

In the face of continued fragmentation of the Single Market, plant-based manufacturers come up against different legislations and a multiplication of technical barriers. In the absence of an EU-led framework, we are also faced with distorting and incoherent national measures creating barriers to consumers' understanding and acceptance of innovative plant-based products. To support the transition to more sustainable food systems and meet the need for continued innovation to provide tasty, nutritious and affordable alternative protein solutions on the European market(s), EU policymakers have to step up.

First, the European Union needs to address the variation of non-tarif measures, such as labelling requirements or denomination restrictions for alternative protein products, as well as streamlining authorisation procedures on all levels for new plant-based ingredients. Innovation in this field can only accelerate if commercialisation is no longer a steeplechase. For plant-based products to be a fully complementary alternative for consumers, a harmonised and level-playing field with the animal-protein sector is necessary.

Second, we need a stronger public-private relationship that can sustain change and incentivise competitive innovation. This could be established through dedicated funding opportunities for the food and drink sector in EU framework programmes like Horizon Europe, thus helping achieve both the green transition and the objectives of the Farm to Fork Strategy.

In sum, there is no lack of drive on the part of the private sector to deliver the means necessary to drive Europe's transition towards more sustainable diets. Large companies are embracing a start-up culture that can drive sustainability and growth through the market, in line with the EU's ambitions. Nestlé's experience has shown that the potential of plant-based proteins can be unlocked to support this transition but that to achieve greater scale more rapidly, a consistent and coherent policy framework for plant-based innovations is needed.

Pekka Lundmark
President & CEO
Nokia

NOKIA

- Green digitalisation
- System
- ✓
- ✓
- Connectivity demands, energy-efficiency targets
- Skills/access to talent; standardisation system issues; public support
- ✓ External partners (e.g., 25GS-PON Multisource Agreement)
- ✓ Enabler of follow-on innovation
- ✓ On-going worldwide
- Challenges need to be addressed

The need for speed

In the digital world, speed is key

Connectivity underpins 21st century industry. It makes it easier for energy grids to include more renewables. It allows factories to increase productivity and virtually eliminate waste. It ensures logistics hubs can send the right things to the right people without delay. And it allows globally distributed workforces to collaborate as smoothly as they would if they were sitting next to each other.

But it's all predicated on speed.

If connections are slow, all those benefits are lost. Cloud-based services, file transfers and even basic communication will all struggle.

With that in mind, it's essential that communities and businesses have access to reliable and fast connectivity – both mobile (for example through 5G) and fixed (through physical cables).

Optical fibre is part of the answer. 25 Gigabit-per-second speed passive optical network (25GPON) is the fastest commercially available fibre access technology, based on Nokia's "Quillion" chipset and developed largely within the EU. 25GPON not only provides higher density and throughput – it also offers power savings of more than 50%, compared to the previous generation of fibre solutions.

As always, better performance unlocks new use cases. 25GPON provides the technical foundation for immersive metaverses, smart city applications and Virtual Reality home entertainment devices.

Factors for success

The successful development of 25GPON began with a clear commitment to R&D. Nokia's leadership is anchored in a well-defined portfolio strategy with a clear vision forward, a stated interest in pioneering a more sustainable future, and significant investment into new technologies. All these were essential.

Software and cross-domain expertise were also critical in driving the 25GPON innovation process. This expertise reflects the multi-party and software-defined reality of next generation networks. It also allowed our engineers to ensure 25GPON being an integral part of software-defined access network evolution and novel use cases.

Collaboration was another enabler of success. This was not only true for the pre-competitive research often supported by EU public funding (such as within the scope of H2020 and Celtic/Eureka) but for all stages up to and including deployment.

Finally, innovation is not insulated from the need to display return-on-investment and sustainable operational excellence. 25GPON has proven to be a powerful solution for a variety of telecoms challenges. As a result, Nokia's research division, Nokia Bell Labs, has already begun exploratory work on 100GPON. Commercialisation stimulates innovation.

Where Europe has to think and invest more strategically

The 25GPON development experience offers a number of lessons learned.

First, the two important building blocks of the 25GPON solution are leading edge chipset technology and System-on-Chip solutions. In order for Europe to secure technology leadership, we need more people with high-level skills in chip design and hardware/software co-design, as well as associated intellectual property expertise. Today those skills are scarce in Europe – if we want to grow (even maintain) our capacities we urgently need to grow chip design talent.

Second, the 25GPON solution faced standardisation-related challenges. Issues of complexity and geo-political bias in international standardisation processes need to be addressed to ensure innovations are not delayed in reaching the market. That said, standardisation should remain private sector-led and Europe needs to further increase the attractiveness of European standardisation.

Third, both coherent political goals and public support for R&D in relevant areas are necessary to maintain and grow a strong European R&D capability. We should continuously assess which relevant technology areas require support and how Europe is progressing in comparison with other regions. Given the society-wide uses and implications of connectivity, we should also consider the role of the public sector, including government agencies, in the innovation ecosystem: where might they add value as early adopters of future PON technologies?

Fourth, the EU Taxonomy provides a classification system for environmentally sustainable economic activities and is designed to channel public financial support and private investment accordingly. At present the taxonomy's approach is too narrow. Advanced telecom connectivity such as fibre and 5G networks should be included in the EU Taxonomy framework as soon as possible. This should be obvious: connectivity possesses a unique ability to support net zero emission targets across almost all sectors of the economy, including in energy intensive industries important for Europe such as chemicals, steel and cement.

Christel Heydemann
CEO
Orange

Climate change

Cooling system

Greening data centers

Internal mindset change, move from research to field implementation

With academic, industrials, telcos, start-ups, standardisation bodies

Building projects, housing

Free cooling for green data centres

The digitalisation of our economies and ways of life have led to an exponential growth in data generation and energy needs. Each day 2.5 quintillion bytes of data are created at our current pace, but that pace is even accelerating with the growth of the Internet of Things. Yet despite its ever-expanding footprint, data storage is perhaps the most invisible part of the information age. In aligning this ever-growing demand with the ongoing energy transition, increasing the energy efficiency of our data centres is key.

During their operation, telecom and information technology equipment convert most of the electric energy received into heat. This heat must be controlled to avoid excessive temperature in the server room and to allow a safe and permanent operation of the equipment.

Classical cooling systems – i.e. air conditioning – displace this heat from inside the building to the outside, but they consume significant amounts of energy – in some data centres even 60% of total consumption. They also use ozone depleting refrigerants.

Tackling the cooling challenge is a key lever for greater energy efficiency.

Lowering the heat

Societal and environmental commitments are at the heart of Orange's strategic plan Engage2025 and we have committed to reduce our CO2 emissions by 30% by 2025 compared to 2015 and to reach net zero carbon by 2040.

After a multi-year effort, we have achieved important improvements in two key areas:

First, we have sourced equipment with greater heat tolerance: climatic ranges have increased from [20-24°C] temperature ranges and [45-65%] relative humidity ranges, to [24-28°C] and [30-75%] respectively. This innovation allows for a 33% decrease of the energy consumption.

Second, for cooling systems we have managed to reduce energy consumption by 90%, by replacing classical air conditioning by an innovative intelligent free cooling system using external fresh air.

Already in 2013, we built the free cooling system into our new big data centre in Normandy, which reached a Power Usage Effectiveness[1] of 1.3, to be compared with 1.8 for Orange's other data centres in France. As a result, we reduced cooling energy consumption by over 50%. Now we are also using that technology in other data centres in France, Belgium and in MEA, like Cameroon.

1 Indicator PUE means ratio between total energy and IT energy measured in one year

Learning by doing

Fifteen years ago, Orange started exploring the concept of using external fresh air instead of air conditioning systems to cool telecommunication equipment rooms, when its temperature and humidity are within ranges defined by European standards.

Then, we raised the issue of heat control through the whole European ecosystem from scientific area and research programs to standardisation and implementation. We contributed to various research projects with other European stakeholders, including vendors and public entities on energy efficiency, like Opera net 1 and 2[2] and SooGreen[3], that led to efficient cooling solutions for central offices and mobile networks.

Concretely speaking, we started with laboratory experiments alongside scientific predictive calculations. Then we secured proof of concept on the field, leading to settings adaptation and improvement where needed, in partnership with manufacturers. We also collaborated with a French start-up that developed new equipment to implement Orange's improved ventilation patent. This was followed by setting up a complete monitoring system internally, to gradually optimise our solution. Finally, we had to identify the best location for the new Orange site, meticulously assessing local climate and topography.

Our journey does not end here. The success of free cooling systems depends on external temperatures, so that they cannot be a 'one-size-fits all' solution. We are currently in the research phase on even more innovative liquid or immersion cooling systems that are less dependent on climate factors. Those next wave solutions are being tested, promoted and co-developed with other stakeholders in our experimental Data Center, named Padus Lab.

Success factors

Our path was not without challenges. Notably it required a mindset change, to internally implement new solutions.

A key driver of our success was our in-house research & development with strong and long-lasting internal cooperation with various units throughout the process, notably to evaluate risks and to adopt and implement a bold move. Also crucial was secured and progressive field implementation. To reach scale we involved ourselves deeply in various European projects (Opera net 1 and 2 and SooGreen) and in the wider ecosystem (academic, standardisation bodies, R&D EU programs, etc).

We also can draw on public (national and European) authorities' support, allowing enhanced cooperation between various actors and stable financing. Here it was and remains key that Orange's commitment is so closely aligned with EU and national objectives for the green transition.

Innovative cooling systems are a building block for better EU cloud solutions

All these explorations are also onboarded in Orange's Project Portfolio for the Important Project of Common European Interest (IPCEI) on Cloud Infrastructure and Services. We will strive for quick progress once the IPCEI is approved by the European Commission.

Companies can achieve a lot but ultimately, strong public and private alliances are needed to complete the green transition. To support the greening of the digital sector and the implementation of innovative solutions, European private and public entities have to work together to achieve sufficient scale on a truly global issue. Further work is needed, especially on standardisation to improve common metrics and through IPCEIs, to speed up research and implementation of innovative solutions.

2 https://www.celticnext.eu/project-opera-net2/

3 https://soogreen.eurestools.eu/

Roy Jakobs
CEO
Royal Philips

PHILIPS

Health

Digital solutions

Customer need

Lack of shared data infrastructures, lack of interoperability, regulatory environment, reimbursement policies

Clinical partners

Also for other healthcare solutions

(For the time being)

Beating cancer with the help of data and AI

Beating cancer with the help of data and AI

Cancer is a disease so common that almost all of us have experience with it one way or another – whether it is as patients, friends, or family members. In 2020, 2.7 million people in the EU were diagnosed with cancer and another 1.3 million lost their lives to it[1].

The good news is that there is more hope than ever for cancer patients and their loved ones. Thanks to advances in digital technology and AI, we now have the tools to detect cancer earlier when it is more treatable. That in turn allows doctors to tailor treatments to the unique needs and characteristics of every patient to promote better outcomes, and support a better quality of life during and after treatment.

Unlocking insights from data

At the heart of the challenge – and the opportunity to accelerate innovation in cancer care – is data. Or more precisely: turning data into actionable insights.

Cancer care teams are collecting ever more information about patients, from medical imaging studies to pathology data, genomics and data stored in electronic health records, as well as treatment outcomes. As the amount of data and the number of specialties involved continues to grow, so does the complexity in integrating and making sense of all this data. Adding to the challenge is that patients often see many different care providers throughout their care journey, with health data increasingly being collected at home and out of the hospital as well. Meanwhile, new treatments become available every day, presenting cancer care teams with a bewildering array of options.

At Philips, we are partnering with healthcare organisations worldwide to help them turn this information overload into meaningful insights at every moment in a patient's care journey – from early screening and detection to diagnosis, treatment, monitoring, and follow-up, including care at home.

For example, together with clinical partners we have developed AI-enabled dashboards that can integrate different types of patient data to improve the efficiency and quality of multi-disciplinary tumor board meetings, while potentially saving up to 24% of the time spent per patient case[2]. Following diagnosis and staging of the patient's cancer, we can offer care teams patient-specific and evidence-based recommendations for therapies or clinical trials, building on our partnership with the world-leading Dana-Farber Cancer Institute in Boston.

1 https://health.ec.europa.eu/system/files/2022-02/eu_cancer-plan_en_0.pdf

2 BMJ Health Care Inform. 2022 Aug;29(1): e100588. http://doi: 10.1136/bmjhci-2022-100588. Effect of digital-enabled multidisciplinary therapy conferences on efficiency and quality of the decision making in prostate cancer care. Erik Ronmark, Ralf Hoffmann, Viktor Skokic, Maud de Klerk-Starmans, Fredrik Jaderling, Pieter Vos, Maudy C W Gayet, Hans Hofstraat, Marco Janssen, Olof Akre, Per Henrik Vincent.

Advanced data analytics and AI offer further possibilities to personalise cancer care. For example, as part of BigMedilytics[3] – an EU-supported big data consortium led by Philips – we have investigated the potential of predictive models to help clinicians and patients make more personalised treatment decisions in prostate cancer care. Working in close collaboration with clinicians, hospital leaders, and patients, with the support of public funding, has been pivotal to the success of these pioneering efforts.

From innovation to implementation: overcoming fragmentation

In spite of the promising results of such innovation programmes, scaling them beyond initial pilot projects has proven to be challenging in Europe. That is because the deployment of AI- and data-enabled solutions in clinical practice is hindered by the fragmented nature of European health systems.

Lack of interoperability and scale, complexities in data access, along with different health data processing rules across the EU all pose barriers[4]. As a result, patients often receive fragmented care as they move from specialist to specialist – with potentially suboptimal outcomes – while cancer care professionals continue to struggle with inefficiencies.

What's the remedy?

Data- and AI-enabled technology will only live up to its full potential in Europe if we overcome this fragmentation and establish interoperable data-sharing infrastructures at scale that make the necessary data available when and where they are needed. The current lack of such infrastructures puts a damper on AI innovation – which is doubly problematic as Europe is globally already lagging behind in AI capabilities.

The creation of common European data spaces could be a game-changer in many industries, including in healthcare where the European Health Data Space promises to enable more seamless data exchange. This will help pave the way towards a more integral, patient-centered approach to cancer care, as outlined in Europe's Beating Cancer Plan – but only if the following three conditions are met.

First, the European Health Data Space needs to span the entire patient journey – making it easier for data to travel with the patient as they move between different departments, institutions, and care settings. To that end, the underlying governance framework should prioritise data standardisation and interoperability, building on internationally recognised standards to create a shared language for healthcare providers to connect and integrate data in meaningful ways. Consistency with GDPR is key, as is promoting further harmonisation in how it is applied across the EU.

Second, cloud-based platforms purpose-built for healthcare can provide the technological foundation to make data flow across healthcare systems, with the necessary privacy, security, and regulatory controls. To move beyond the current piecemeal approach in the adoption of cloud in healthcare, more European dialogue and transnational agreements are needed.

Third, to support adoption of digital innovations in cancer care at scale, reimbursement mechanisms should better reflect the value delivered to patients across their entire care journey.

Radical innovation of this kind requires a public sector rethink across many dimensions. In the fight against cancer, it could literally save lives and offer patients across Europe a brighter outlook for the future.

3 BigMedilytics is a consortium of 35 entities, led by Philips, in which healthcare providers, technology companies, pharma, research institutes and universities from 12 different countries participate: https://www.bigmedilytics.eu/

4 https://health.ec.europa.eu/publications/assessment-eu-member-states-rules-health-data-light-gdpr_en

Jakob Stausholm
CEO
Rio Tinto

RioTinto

Climate change, emissions

Process

Customer demand, government request, research

Commercialisation

External partners (industry and governments)

Across society at large

For now outside Europe

A lightweight revolution

Aluminium is lightweight, strong, and infinitely recyclable. It is also the leading choice for sustainable product development. Aluminium is essential for low-carbon solutions, including lightweight cars and energy efficient buildings – its weakness is that it takes a lot of energy to produce it – also because its production processes have been essentially the same since 1886.

The main challenge for aluminium – as a material for the green transition – is therefore to find ways to decarbonise the way it is made, by ensuring that the electricity used for smelting is renewable, and that we eliminate the use of carbon anodes in the smelting process itself, and it is on this latter point, where we have made a breakthrough.

Smelting aluminium – GHG-free

In 2018 we partnered with Alcoa, supported by Apple and the Governments of Canada and Quebec, on ELYSIS™, a joint venture to help further develop breakthrough aluminium smelting technology that produces no direct greenhouse gas (GHG) emissions. In November 2021, ELYSIS successfully produced GHG-emission-free aluminium at its Industrial Research and Development Center in Saguenay, Quebec, Canada.

The ELYSIS™ technology effectively puts an end to the use of carbon anode in the aluminium smelting process. Over the last one hundred years, manufacturing of aluminium has involved an electrolytic process where aluminium oxide dissolved in a fluoride-based molten electrolyte is split into aluminium and oxygen. The aluminium is recovered in molten form and the oxygen reacts with the carbon anode to produce CO2, and in doing so consumes the carbon anode. ELYSIS™ features newly developed breakthrough proprietary materials that are stable and are not consumed during the process. Thus, it eliminates all direct greenhouse gas (GHG) emissions from the aluminium smelting process and only emits oxygen as its by-product. This is a fundamental change of a hundred-year-old manufacturing process.

ELYSIS™ technology has the potential to transform the aluminium industry through a significant reduction in its carbon footprint. In Canada alone, the use of ELYSIS™ technology could reduce GHG emissions by 6.5 million metric tons – the equivalent of removing 1.8 million cars from the roads.

Does this innovation have a future? It certainly does. First, the ELYSIS™ technology – which can be used in both new and existing aluminium smelters – will reduce operating costs at aluminium smelters, while increasing production capacity. Second, demand is basically assured, as it will allow aluminium customers to decarbonise their supply chain, in line with growing demand from consumers. Aluminium produced during the ELYSIS™ research and development stage has already been used by Apple, ABInBev for Michelob Ultra cans and Audi for the wheels on its eTron GT.

Scaling up for commercialisation

Following the breakthrough in 2021, there is still more work to do before the technology can be used commercially. The focus is now on accelerating the scale-up of the technology towards the demonstration of even larger commercial-size cells in 2023.

Construction of these prototype cells is well underway at our Alma aluminium smelter. With the current development pathway, ELYSIS aims to have its technology available for installation from 2024 and the production of larger volumes of carbon-free aluminium approximately two years later.

Shared conviction – joint action

No company alone will solve the decarbonisation challenge. We need to collaborate across our supply chain, including partnerships with customers, technology providers, research institutes, government, and other stakeholders.

Rio Tinto, Alcoa, the Government of Canada and the Government of Quebec provided a combined investment of CAD 228 million to create ELYSIS and to see this technology reach commercial maturity. The Canadian Government and the Quebec Government, through the participation of Investment Quebec, have decided to support and be part of this industry revolution, each investing CAD 80 million in ELYSIS. Their support has ensured that this breakthrough technology and the birth of a revolutionary new aluminium smelting industry took place in Quebec.

World technology giant Apple helped facilitate the collaboration between Alcoa and Rio Tinto on the carbon-free smelting process and, in addition to investing CAD 13 million, has agreed to provide ELYSIS with technical support.

ELYSIS is an excellent example of industrial partnerships bringing together competitors, customers, and governments to facilitate breakthrough technologies and investments in R&D.

Potential for Europe

A key reason why we chose to develop the ELYSIS™ technology in Canada was the abundance of renewable energy. Combined, Rio Tinto and Alcoa operate 10 aluminium smelters in Canada, all using 100% renewable energy. Access to green energy ensures that aluminium produced by ELYSIS is 100% carbon neutral. But that was only one reason.

Both governments had a vision that this new technology should see the light of day on their turf – and they followed this through hands-on. The EU on the other hand, whilst visionary on the green transition and newly ambitious with its Green Deal Industrial Plan, seems to have a much more complex – even reluctant – relationship with public investment in private sector initiatives. This has to change if Europe's political class wants to see new breakthrough technologies being developed in Europe and contributing to the long-term competitiveness of European industry. If we could make it speedier and more accessible, the Important Project of Common European Interest (IPCEI) model would be ideally suited to bring partners together along the value chain.

The global competitiveness of technologies such as ELYSIS™ will depend on whether policymakers will ensure that the true cost of carbon is priced in. A market-based price on carbon is the most effective way to incentivise the private sector to make low-carbon investments and drive down emissions. A range of policy measures is necessary to support the early movers in our sector that innovate and deploy low-carbon technology.

Christoph Franz
Former Chairman
of the Board
Roche

Roche

Global health threat

Product & diagnostics

Growing number of deaths, often following hospital-acquired bacterial infections.

Scientific challenge, lack of market incentive

Global industry partnerships; private-public partnerships

Depending on stronger market incentives

(In this specific area)

A silent pandemic, screaming for action

A silent pandemic, screaming for action

Inappropriate use of antibiotics in people, animals and plants has led to multidrug-resistant infections. Antimicrobial resistance (AMR) is a “silent pandemic”, spreading around the world at a slow but constant pace. It is projected to soon claim more lives than cancer does today.

In antibiotics, R&D innovation has been stagnant for decades, due both to significant scientific challenges as well as a marketplace that fails to reward innovation in this therapeutic area. In addition, with the necessary prudent use of antibiotics, the per-unit business model doesn’t work. In short, a low return on investment causes market failure.

A study published recently in Lancet[1] suggests that in 2019, 1.27 million deaths globally were the direct result of drug-resistant bacterial infections. If nothing is done to stop it, experts predict that ten million people might die from such infections by 2050 – every year. Today’s 33’000 deaths in Europe will then be dwarfed by almost 400’000 losses of life per year. Deaths attributable to antibiotic-resistant bacterial infections increased by 25% over six years in the EU. Already today, premature mortality results in years of life lost, equal to HIV, tuberculosis and flu combined.

Hope lies in next generation antibiotics

Roche has a long history of developing anti-infectives. Three of them are on the WHO Model List of Essential Medicines and have saved millions of lives. And they still do today.

Roche is unique in investing both in R&D of antibiotics against some of the most serious infections as well as in diagnostic solutions to tackle AMR. The company is committed to bringing to patients novel medicines that can provide long-term solutions to the AMR crisis.

In its search for next-generation antibiotics, Roche is working both on broad-spectrum antibiotics and on specific pathogens, including the top three bacteria on the WHO priority pathogen and CDC urgent threat lists. Roche scientists are applying synthetic biology and genome-mining approaches to discover novel molecules against some of the most resistant germs.

To complement our in-house research, Roche is using a wide range of approaches, from local partnerships to global industry collaborations such as the AMR Action Fund, initiated by the International Federation of Pharmaceutical Manufacturers and Associations. Roche has also joined forces in a private-public-partnership with the Biomedical Advanced Research and Development Authority in the U.S. to advance the development of medicines for infectious diseases.

1 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The Lancet. 20 January 2022. doi:10.1016/S0140-6736(21)02724-0.

The group of most resistant bacteria includes Enterobacteriaceae and Acinetobacter species. Often, these germs are present in the hospital environment. There, they can cause severe infections with a high mortality rate, especially in vulnerable patients in intensive care.

Rapid tests slow down resistance

In this setting, the role of diagnostics is crucial, e.g., to detect colonised patients and prevent the spread of the infections. Roche continues to invest in private research and partnerships around new classes of molecular diagnostics. The latest focus – underlined by the acquisition of a leading provider in the field – is on so-called syndromic tests. From just one patient sample, such tests can detect dozens of pathogens and antibiotic resistances in hours, not in days. Therefore, a doctor can prescribe the right therapeutic within hours – and save precious time to slow down a potential contamination of other people.

Receiving the test results fast will also prevent doctors from prescribing antibiotics prematurely, because they might believe “it can’t hurt”. However, the more antibiotics are prescribed, the more bacteria become resistant. This is one major cause of AMR and puts the whole world population at risk.

Fatefully connected: Business model and patient benefit

The conventional pharmaceutical business model, in which revenues are based on volume sales, is not appropriate for antibiotics that must be used sparingly to maintain their efficacy. Research in this area is therefore overshadowed by financial risk and the prospect of low return. To overcome this, incentive setting is key.

Push incentives are already well established. They include research grants, tax breaks or public–private research partnerships as ways to reduce the financial risks of research. Push incentives remain crucial for a sustainable long-term antibiotics ecosystem.

Pull incentives aim to increase the available number of antibiotics by “pulling” them through the system as quickly as possible, to market authorisation. The most common pull incentives also support stewardship efforts across the health system by de-linking the manufacturer's return on investment from volume of sales. In practice, they provide a known and predictable return on investment for the successful development of new antibiotics. Yet to make pull incentives effective, a few building blocks are missing.

The EU should use the upcoming EU Pharma Legislative Review to take a lead in developing new market models such as transferable exclusivity extensions (TEEs). To be effective, pull incentives need to be accompanied by different types of regulatory and reimbursement models and valuation methodologies. This will ensure the amount paid by governments or insurers for novel antibiotics reflects their societal and clinical value. New access models for innovative diagnostics are also needed so that new, rapid and reliable solutions are available to clinicians and patients.

AMR is a global problem where a collective response with market reforms that foster innovation is key. Global manufacturers can bring national stakeholders together and spread good practice – to build a global ecosystem that supports investment and stewardship in AMR.

Güler Sabanci
Chair
Sabancı Holding

SABANCI

Circularity, safety

Substance replacement

Customer demand for sustainable solutions, future regulatory requirements

Replacement of an almost a century old global standard, long/costly approval process, immature technologies

(Customers and suppliers)

A long journey to sustainable tires

According to the latest projections, global population could grow to around 8.5 billion in 2030 and 9.7 billion in 2050. Sustaining the current lifestyles of 9.7 billion people based on current production practices would require the natural resources of almost three planets Earth.

There is no way around it – we will have to rethink how we make better use of our resources – including materials ending up as un-recycled waste. For example, Polyethylene Terephthalate (PET) is the third most used polymer globally and serves in a wide range of multi-layer composite products such as tyres, textiles and packaging. Most of the PET waste is currently landfilled or burnt – but it could also be retrieved to create a sustainable industry.

For the tyre industry, PET is one of the main reinforcing textile materials. And for the textile material to get the necessary bonding to rubber, the industry has been using Resorcinol-Formaldehyde-Latex (RFL)-based adhesive systems since the late 1930s, even though health-related concerns persist.

Kordsa, a subsidiary of Sabancı Holding and a global leader on tyre reinforcement technologies, is determined to tackle both challenges and to reduce its carbon footprint by implementing new generation technologies that allow for more sustainable transportation solutions. Several years of research efforts to contribute to its "tyres with more sustainable materials" target, finally culminate in the development of two new technologies.

A double effort

First, Kordsa and Continental – who have been collaborating for many years on tyre textile reinforcements – joined forces in 2017 to replace resorcinol and formaldehyde with more environmentally friendly alternatives to reinforcing rubber with technical fibers. These fibers are needed to provide satisfactory mechanical properties that are crucial for the performance of many heavy-duty mechanical rubber goods, and especially tyres.

Developers from both companies exchanged the know-how they had acquired, discussed options, created concepts to overcome prior limitations and tested various technologies. This partnership was also complementary thanks to both sides sharing experience in tyre cord production, thus enhancing speed and efficiency. The high quality of collaboration eventually paid off with a novel RF-free formulation that yielded similar results to the RFL standard not only in laboratory tests, but also in tyre tests – the COKOON adhesive technology. COKOON does not compromise on safety or performance criteria. First series tyres featuring COKOON technology have already been on the road and Continental is expected to expand the use of COKOON technology in their tyre production in the near future.

Second, Kordsa has created a new tyre-reinforcing high-tenacity fiber from waste PET bottles, expanding its sustainable product range to meet an evolving demand by tyre manufacturers – the majority of whom have set themselves the target to manufacture “tyres

made of 100% sustainable materials by 2050".

A part of the project focuses on manufacturing PET tyre cord fabric using chemically recycled polyester chips from waste plastic bottles. Compared to other recycling technologies, recycling from waste plastic bottles is at higher technology readiness level and will make it possible to produce this main tyre reinforcement component without using virgin PET.

Over the course of this recycling innovation, Kordsa has investigated different polyester recycling technologies, and has become a partner, along with Michelin, in the European Commission's Horizon Europe "WhiteCycle" project which focuses on the recycling of complex PET by enzymatic reaction technology. As part of this €7.1 million budgeted project, Kordsa is giving high priority to projects targeting circularity. We are committed to enhancing the use of complex PET waste to produce high performance sustainable products.

Adapting to value chain realities

The fact that COKOON, a promising alternative to RFL adhesive technology, has been developed does not mean that it will be easy to replace an almost century-old standard, which was an approved, long-tested system with which every tyre manufacturer seemed to be satisfied.

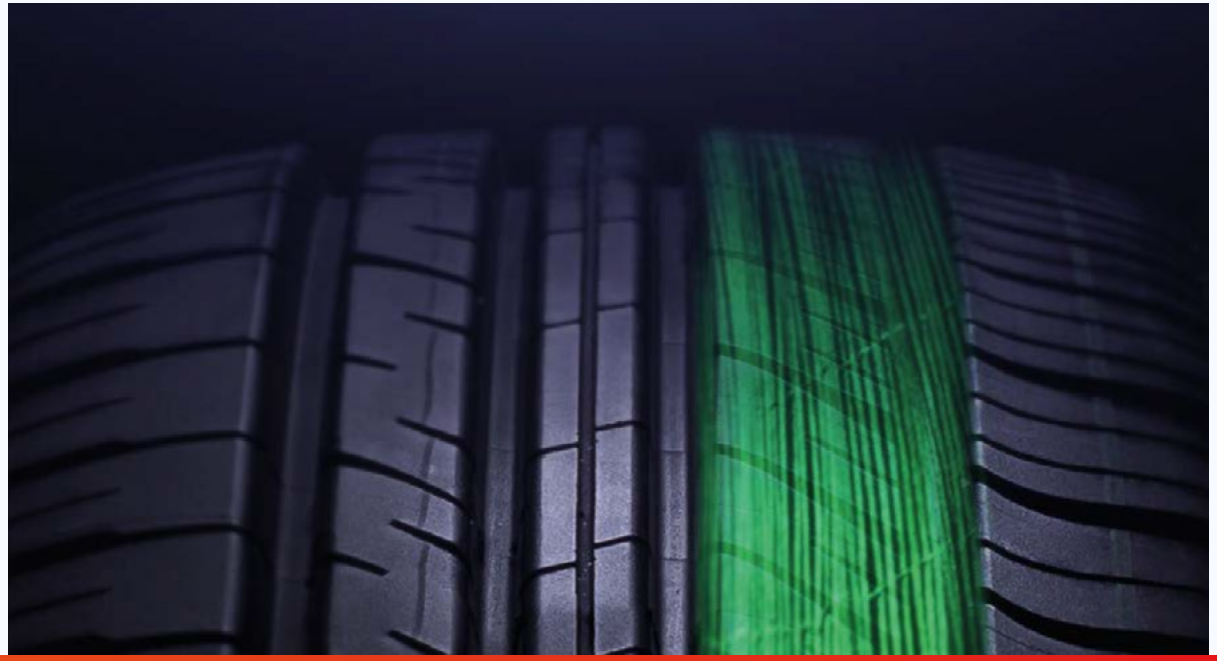
Currently, several textile suppliers provide only a single adhesion technology (i.e. RFL) to tyre manufacturers. However, in the case of new RF-free technologies – and from a tyre producers' perspective – the approval process could become much more complex and costlier since numerous textile converters are working on their own alternative adhesion technologies. There is the risk that approval processes and the added IP-related complexities for each new adhesion technology could make tyre manufacturers reluctant to try those new technologies.

In spite of these hurdles, it is obvious that the industry needs to seek sustainable and responsible solutions to meet future needs. To overcome the bottlenecks which stand in the way of viable business solutions – and to lay the foundation for a new industry-wide standard parallel to that of RFL – Kordsa and Continental have decided to make the COKOON technology available for everyone through free licensing. This move opens up this innovation project to all parties interested in contributing to a greener world.

As of today, more than 40 textile converters and tyre manufacturers have tested the material and 10 companies joined the free licensing pool. We believe that the more stakeholders join in, the higher the benefit will be for all parties and that COKOON can help transform the industry for the sake of a sustainable future.

Regarding PET recycling technologies, there is still work left to do: A current state of the art is not fully developed and raw material supply is not yet secure. Currently, the only available resource is bottle waste, but bottle producers increasingly seek to close the bottle-to-bottle loop. As an alternative resource, we are now looking into blended textile waste and PET from end-of-life-time tyres (ELT).

In short, the success of innovation also depends on adapting to the value chain as a whole and navigating dynamics of both demand for new solutions and competition for raw materials.



Christian Klein
CEO and Member of the Executive Board
SAP SE

	Circularity, supply chain traceability
	Digital twin tokens
✓	But not initially
✓	Across the value chain (material origin to final product).
	Staff initiative, cross-fertilisation from commodities trading experience
	Lack of EU standards, lack of incentives for customers, GDPR
✓	Input from standard agencies and auditors, piloted with customers
✓	
✓	
👍	Still grey zones in legislation

Tracing the perfect circle

Over the past decade, supply chains have increasingly become outsourced, more complex, and more vulnerable. More than ever, companies must anticipate risks, respond to disruptions, and manage demand and supply in real time. Coupled with all this, sustainability has become an economic imperative. The environmental, social and governance (ESG) impacts of corporate decisions are becoming an integral part of corporate strategy and management.

As governments, companies and individuals adapt to tackling climate change, there is an increased pressure to stop most of the plastic waste from ending up in our oceans, being burnt or sent to landfills and instead, use this waste to produce new products in a circular and certified sustainable manner.

Digital twin token as an enabler for the circular plastics economy

As new products made from certified circular recycled plastic waste are physically indistinguishable from conventional products, companies need an easy way to provide reliable and auditable proof of the sustainability and circularity content to their customers and stakeholders. GreenToken by SAP® was born to address this challenge.

Over their 30-year careers in commodity trading, the cofounders of GreenToken by SAP® have realised it is almost impossible to link the commodity raw material to ESG facts, even though these actually are among the key features that influence customer decisions. To reverse this situation, an innovation of tokens that represent underlying raw material as a digital twin was triggered and prompted the success of the GreenToken by SAP®.

Using digital twin tokens based on blockchain technology, GreenToken by SAP® allows for end-to-end supply chain transparency and traceability. Raw materials can be tracked from the first point of aggregation along the supply chain to the end customer.

The two cofounders, both SAP employees, pitched the idea to the SAP.io Venture Studio in 2019. Following a rigorous selection process, they were one of two teams selected from over 300 applicants who were given the opportunity to start an internal SAP venture, supported by funding from SAP Venture Studios.

Over 65 companies were consulted as part of the innovation process. Chemical champions BASF, IMCD, SCG, and Mitsubishi Chemical Europe piloted GreenToken by SAP® to help their customers understand how much recycled material is contained in their products. SAP also consulted with standardisation agencies, such as ISCC, and auditors, such as SGS. After two years of development, the product is now part of the SAP sustainability suite of tools.

By capturing unique attributes and information such as commodity origin or carbon footprint, GreenToken by SAP® enables customers to accelerate the industry's shift to circular and hence certified sustainable material use. GreenToken by SAP® is applicable as a network-based solution for effective and efficient

traceability and transparency of circularity across multiple supply chain partners, or within a single company. Effectively, it is applicable to any industry basing its production on raw material, to prove ESG facts about its origin, or how it was made or processed. Thanks to its features, it supports neither deforestation in agri raw material sourcing nor child labour mineral sourcing, amongst others.

A wider commercialisation of the solution is underway, marked by a deal with a big European consumer packages goods company.

Although not developed as a publicly co-funded initiative, GreenToken by SAP® was designed with existing and upcoming environmental policies in mind. The solution is to meet material traceability standards in Europe, i.e. requirements raising from the EU Green Deal package, German Lieferkettensorgfaltspflichtengesetz, and the International Sustainability and Carbon Certification (ISCC).

As a result, GreenToken by SAP® is successful as a stand-alone intra company system for tracking sustainability credits to ISCC+, ISCC EU, or RedCert standards.

Following its creation, GreenToken by SAP® was invited to join the INCREASE project, funded by the EU (https://increace-project.eu/about-us/).

Towards an innovation friendly environment

As new circular content EU standards come into force, GreenToken by SAP® can allow EU companies to easily show their commitment to run their business sustainably, especially as the same token system has already been proven to have hundreds of applications across the entire value chain for many different products and industries.

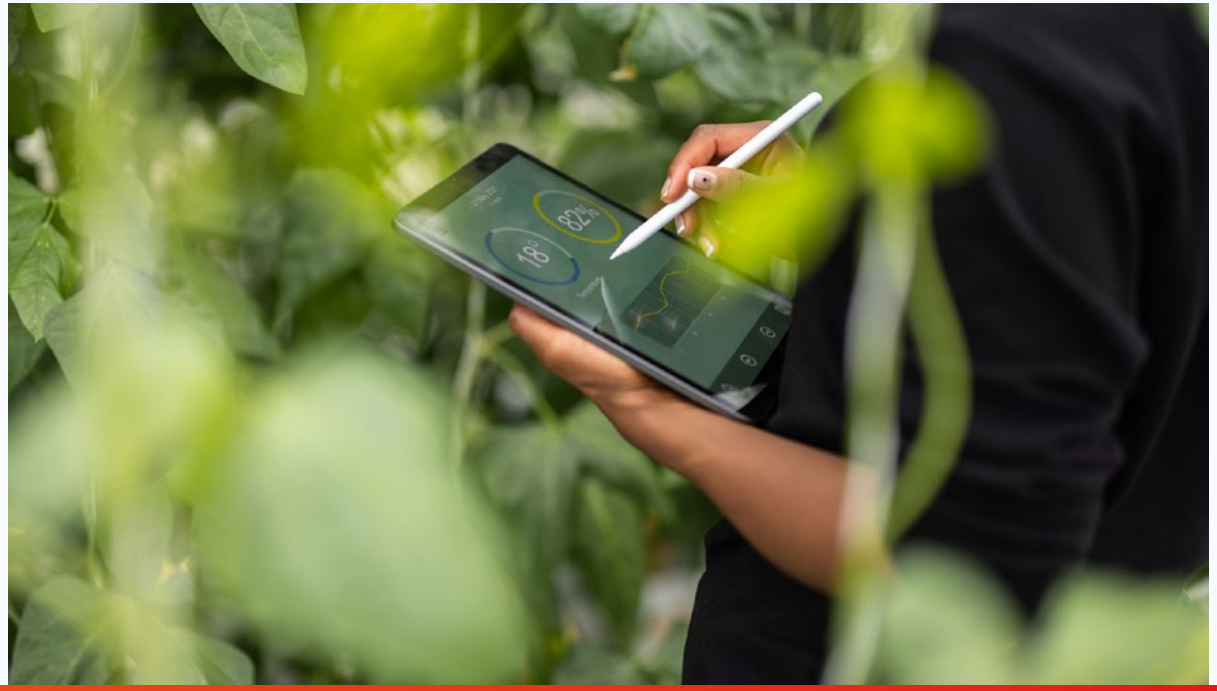
That said – the story of the GreenToken by SAP® is also a story of a legislative framework that is adapting too slowly to ground-breaking innovation.

The issue starts with a lack of straightforward EU definitions – for example: what does circular chemicals /plastic mean according to EU certification rules? How is low carbon green hydrogen defined? How is equivalence achieved for circular products coming from outside the EU?

Secondly, there is a lack of incentives that would overcome companies' reluctance to switch to more innovative solutions. For example, an EU plastic tax could be a great incentive to make EU companies report on their circular products, especially if they get financial incentives for investing in circular product production. Law makers could be more creative in boosting the business case for innovations that contribute to important political goals.

Last, the review of legal data agreements, even though necessary to conform to GDPR, often slows down the development and roll out of new technology solutions. A simplified way to hold conformity reviews under GDPR, especially when no personal data is processed, would speed up innovation.

Europe has the technological capacities, talent and industrial liaisons to enable ground-breaking innovation – yet innovation often lacks a business case. We can change this by bringing regulation in sync with political goals.



Wael Sawan
CEO
Shell

Circularity, plastics pollution reduction

Process

CEO-set target, societal demand

Cross-sector collaboration, permitting / regulatory barriers in different countries

External partners along the value chain

Yet, the technology unlocks circular chemical products across sectors

Conditional on EU policy framework and removal of regulatory barriers across EU

But still lacking: an enabling policy framework to allow for scale-up in EU

Closing the plastic loop

Plastic products bring important benefits to society – they help improve living standards and deliver health, safety and sustainability benefits. Plastic waste, however, is a global issue and where waste is not managed appropriately, it ends up polluting the environment. Estimates suggest that of the 353 million tonnes of plastic waste generated globally, only 9% is recycled, and the remainder goes to landfill or incineration – or is unmanaged after use .

Shell, alongside many others, is committed to finding lasting solutions to plastic waste. We want to play our part in the transformation of the plastics value chain from linear to circular, reducing the need for raw materials and introducing more recycled products into everyday life.

Chemical recycling: key to tackling plastic waste

In recent decades, plastic recycling has mostly been limited to plastic waste streams which are relatively easy to collect and mechanically recycle like drink bottles or milk containers. However, alternative techniques are needed for plastics that cannot be mechanically recycled and are currently incinerated or go to landfill. These are hard to recycle plastics like snack bags, plastic film, garden furniture and others.

Chemical or advanced recycling uses different technologies to expand the types of plastics that can be recycled. Shell is working on several technologies to utilise waste and is focusing particularly on chemical recycling through pyrolysis: a special heating process that turns hard-to-recycle plastics into a liquid. This liquid, referred to as pyrolysis oil, replaces virgin hydrocarbons in the production of chemicals which are the building blocks of a wide range of products we use every day, including new plastic products.

A complementary solution to mechanical recycling, chemical recycling can help improve recycling rates and introduce products with more recycled content to the market. We are looking at this through a global lens: if plastic waste can become a valuable resource also in other parts of the world, incentives for its collection and management will be stronger than ever before.

Building a circular value chain

To grow the market for pyrolysis oil to required industrial quantities, Shell is working with partners at different stages of the value chain and across various industries, including the waste management industry and small and medium enterprise pyrolysis oil producers.

In 2021, Shell invested in the start-up company BlueAlp and together we are working to develop, scale and deploy BlueAlp's plastic waste to chemicals technology. Already at a commercial scale, Shell's experience and size will help further improve and expand the technology's capacity to recycle larger volumes of plastic waste. BlueAlp's technology will be licensed globally to support the growth of pyrolysis oil production.

In the Netherlands, Shell and BlueAlp will build two plastic waste conversion units with the combined capacity to process approximately 30,000 tonnes a year of tough-to-recycle plastic waste. The units are expected to be operational in 2024 and Shell will use all the pyrolysis oil produced at its plants in Moerdijk and Rheinland.

We have also developed a technology to tackle the industry-wide challenge of inconsistent purity of pyrolysis oil, which still impedes the growth of the market. Shell's proprietary upgrader technology improves the quality of pyrolysis oil that can be fed to a cracker and will allow the use of pyrolysis oil with a wider range of characteristics. We are currently investing in two pyrolysis upgrading units with one each in Moerdijk and Singapore.

Collaboration is key to enabling the circular value chain. In addition to our investment in BlueAlp, we are establishing long term relationships with pyrolysis oil producers and guaranteeing offtake agreements for Shell's crackers in Europe, Asia and the United States. We are also building strategic alliances with waste management and recycling companies to unlock currently inaccessible waste streams and help drive industry growth.

Enabling policy frameworks

A supportive policy environment can help unlock innovation and investment but also gives rise to some uncertainty that could hold back growth. In our case, the EU is a driving force with its Circular Economy Action Plan and Strategy for Plastics in a Circular Economy and related legislation on waste collection and recycling as well as on sustainable carbon cycles. This creates a lot of potential for innovation like ours, but also the risk of bias towards an overly narrow set of solutions for political reasons. For example, uncertainty will prevail as long as it is not clear that the new rules will provide a level playing field between chemical and mechanical recycling. Similarly, if the opportunity to secure steady flows within the Single Market for both our input materials (i.e. waste) and our output material (pyrolysis oil), is missed.

Policy frameworks are important innovation enablers, provided they embrace innovation and consider the full value chain, from access to resources (in our case waste) to encouraging uptake by end users. This is especially true for innovations in the circular economy.

Jim Hagemann Snabe
Chairman
Siemens

SIEMENS

Green transition, public transport as a mobility solution	
Product	
	✓
IT & Software sector, (Cyber) security, public transport sector	✓
Latest breakthrough technology, customer demand	
Lack of testing facilities and data, availability of information (data)	
Internal and external technology experts, involvement of internal and customers' experts for data privacy & data security	✓
Buildings, public spaces...	✓
Depending on EU AI legislation – forbidding AI based emotion detection would prevent commercialization within the EU	?

Safer with AI

Artificial Intelligence (AI) opens up possibilities not only in the Business-to-Consumer area, but also in the Business-to-Business domain. Industrial AI applications present great opportunities that can contribute to resolving major challenges facing our society. For example, Industrial AI can make significant improvements and enhance and augment (not replace) human capacities in the power and mobility sectors, and in industrial manufacturing, critical infrastructure and building automation. Within those areas, we see many applications where trustworthy industrial AI and data are the means – instruments or tools – to achieve the twin digital and green transition of society and industry, towards a more sustainable and truly circular economy.

To name but a few examples, AI applications in the industrial domain can cover a very broad variety of tasks with many grades of complexity and autonomy. These range from visualising existing data or recognising patterns or objects in data, to data-based predictions on future states/ events and even recommending actions to human operators. And indeed, AI can also autonomously control and operate an end-to-end decision process (e.g. collaborative robots, autonomous driving...). The areas where industrial AI can enable important innovations or support the twin digital & green transformation of industry and society are nearly infinite – often with direct benefits beyond the industry introducing them. Using AI in transportation can also increase asset utilisation and thus reduce carbon emissions.

In our example, Siemens was approached by public transport providers in Germany with an innovation challenge to help make public transport safer and more convenient. The goal was to increase the attractiveness of taking the train, tram or metro vis-à-vis car rides – also supporting the de-congestion of city centres and increasing social equality by providing safe mobility for everyone.

AI can make public transport safer, more secure[1] and more convenient

How can this be achieved? By building AI into established solutions: a conventional closed-circuit television (CCTV) system on a train or tram can be equipped with AI-Edge technology and multi-sensor systems that can automatically pre-process and analyse visual sensor data (video analytics).

Several types of relevant live information can be extracted by processing CCTV video streams with AI. AI can direct passengers to vacant seats, wheelchair spaces or less crowded carriages when trains are arriving at the platform. And to increase security, AI can alert staff in the control room to events of aggression, as it detects aggressive movement patters – enabling faster human decisions to provide help.

1 We talk about safety and security as two distinct characteristics: While safety is dealing with unintended failure of the system, security is comprising the intended corruption of the system for example sabotage, intrusion etc.

The application was developed in a step-by step approach, together with a network of internal and external technology experts in Computer Vision, AI and Train-IT hardware and software. Right from the onset, we involved experts for data privacy & data security from internal units and from our customers, given how important these aspects are for such applications.

For new applications we generally follow a four-step approach: We start with a technological innovation idea, followed by a technical feasibility assessment by experts in computer vision and AI. The next step is the prioritisation of use cases for product development. Once successful, we test the application in real operation. When we are satisfied, we present the added value of this innovation to potential customers.

We financed these developments mostly from the own R&D budget, partly co-financed through national and regional public funding programs.

A major challenge, especially in the development and implementation phase, was to find sufficient training and test data for these AI-based systems, also due to data protection rules. In the early stages, we worked around this constraint, by hiring actors to artificially create the data sets we needed.

As of now, a first train operator in Germany has decided to buy and use our AI-based aggression detection (iCCTV) for their new trains, whilst other operators are also showing interest.

Are Europe's policymakers ready for AI-based innovation?

The European Commission understands that legislation must be designed in a way that creates the best possible conditions for innovation to flourish, as underlined by its own Innovation Principle. But are EU policymakers ready to stick to this principle when it comes to AI? The answer to this question is not yet clear but will have considerable implications on our ability to innovate in this field and remain competitive.

AI is an emerging technology that will be part of our future. It offers huge innovation potential. It is also a truly global technology. We cannot call ourselves an innovation-friendly economy, if we stifle innovation in Europe's AI capabilities through overregulation and disproportionate administrative burden, losing sight of the very real benefits this technology can bring.

Looking at the AI Act as an example – what traps does the EU need to avoid in order to remain an agile innovator?

First, do not neglect evolution over time: review clauses are key, as they enable to re-assess the impact of legislation on innovation and competitiveness of EU industry and set a timetable for making necessary adjustments.

Second, do not lose sight of the purpose of rules: rules that are designed to protect consumers (for example their personal data and privacy) should not be blindly copy-pasted to a Business-to-Business (B2B) environment (where what matters are industrial / machine data).

Third, a legislation does more harm than good if it adopts a horizontal "one-size-fits-all" solution for a wide range of applications in very diverse industries. In our example, a blanket or horizontal ban on the use of AI to recognise aggression without even looking at the criticality of the application itself, would prohibit the use of such innovation on trains and trams in Europe – and probably all similar attempts to make public spaces safer.

Cláudia Azevedo
CEO
Sonae

Sonae

Personalised Services

Product

Improving product offer

Data collection

A Portuguese collaborative laboratory

Still in planning phase

Smartening up your home

We all see the rapid changes in “things” we interact with every day. Do you notice how they are getting smarter and more adapted to the needs and personalities of each of us? For an interactive device, identifying and characterising its users, is a key factor to allow the “smart” delivery of personalised services.

Such user-personalisation in turn is fed by the information collected and mapped about the individuals that explore and use a service/product. And yet, less than 5% of customers use the profiling features that would provide this information to their device. As a result, we as developers face some interesting challenges when building personal experiences.

Our sector has already tried several personalisation technologies, including some based on Machine Learning (ML). However, those pose great challenges in terms of privacy and security, as shared data are easily hackable which leads to low-restriction access to sensible user information in the context of “always-on” technologies. Developers have tried to overcome this, for example via fingerprinting technologies (available in most smartphones in 2022), bioimpedance (Zensei system) and even Electrocardiograms (ECG) – all examples of user-friendly, discrete, comfortable and secure systems that allow identification of the user. Yet, all these tools are expensive, even in the mass market. Could we find a solution that is as safe, but more affordable?

A new era of personalised electronic devices?

Very recently, it has become possible to print mass electronic devices on paper. A new era of flexible and low cost, sustainable and “smart” electronics based on paper is about to start!

NOS by Sonae – in collaboration with a Portuguese Collaborative Lab AlmaScience – designed a private investment, a three-months project intended to create a variety of cost-effective “add-on” flexible electronic elements to integrate within NOS’s home devices. In the short-term, the aim would be to improve the TV user experience. In the long-term, the goal is to offer customers an immersive “smart and connected” NOS home experience.

Our plan is to leverage paper electronics to create sensors and make devices smarter – making the world we interact with smarter too. For example, a standard device like the remote control of your TV could sense who it is interacting with, and even their mood, and adapt the user experience to those conditions. With this technology, we could create devices that can sense if we need them and that are there for us when we need them the most.

This innovation is at an early stage of product design. It is an outcome of the current Research & Innovation programme at NOS which is based on two pillars. First, the co-collaboration and cooperation between the company and research institutes helps bring the most valuable R&D assets to the market. Second, it drives the implementation of fast prototyping

techniques that lead to radical innovation. In this example, our strategy was able to demonstrate the potential value of technology in the context of user personalisation, to support decision-making and decrease project risks.

Putting the finger on the spot

Following the rule of thumb of Artificial Intelligence/Machine Learning initiatives, the development of "smart things" requires "smart data". In our project we had to redesign and implement innovative processes to rapidly collect significant data in a short timeframe at low cost. In particular, we had to find new ways to acquire data in compliance with GDPR national regulations and set up several use-cases/prototypes. This was a challenge as in the Portuguese context, the transposition of GDPR rules gives rise to specific national constraints. We have learned from this experience that innovation would be greatly facilitated by an EU-wide GDPR horizontal framework for R&D projects – if done right, this would accelerate pilots/trials across the innovation cycle.

Another discovery was the submission of a co-ownership patent to ensure the protection of the main outcomes of the project, particularly to allow partners to create new businesses and explore new markets for industry or research purposes. Protecting results is fundamental in an innovation strategy and intellectual property is a strong tangible asset with high impact on the economic sustainability of a company or research entity as well as for valuation processes when high-risk investments are involved.

We are currently experiencing obstacles on a step-by-step path to the market. Although the functional prototype serves as a clear demonstrator of a potential new product, there are several demanding steps to transform this prototype into a product, ensuring it fits either the market opportunity and needs, or the financial criteria to scale up. The definition of a clear business case with precise steps to reach the market is mandatory to pass the different gates of the innovation process. And, although some methodologies, such as the lean methodology, are available to engage the main stakeholders and accelerate feedback collection and implementation, it is a long road from innovation to monetisation.

Europe's business model is 'growth through innovation' and yet we are stuck below potential in the acceleration of innovation. Accelerating innovation implies taking advantage of the identified business opportunity, but also receiving ecosystem catalysts, a reality that is being very slowly implemented in the context of the European Union incentives and innovation frameworks.

What can we do to get better at transposing our R&D expertise and assets to the business market? We should – without delay – start by creating more "natural and well-referenced" innovative clusters where researchers, start-up entrepreneurs, investors, businesses and governments can co-generate tomorrow's competitive paradigm. All things around us are getting smarter – let us also smarten up our innovation environment.

José María Álvarez-Pallete
Chairman & CEO
Telefónica

Telefónica

Digital transformation of industries

Process & product

Need to test the 5G technology

Developing / testing technical solutions, processes approach, cross-sectoral co-innovation

Strong external co-innovation and internal support

Across several sectors, society at large

5G deployment and services

With some funding support

A 5G testbed for Industry 4.0

Towards a new industrial revolution

Europe's future industrial competitiveness hinges on our innovation powers and our ability to complete the green and digital transitions. Making Industry 4.0 a success is therefore vital, and a task for, amongst others, Europe's telecoms companies.

Properly digitalising an industrial factory is key to improving flexibility and efficiency and enabling real-time decision making. It is not a small task as it requires connecting, processing, and acting on massive amounts of data in real time and with centralised data management. The ability to achieve this digital transformation, with 5G, edge cloud and digital twin technologies will be one of the founding blocks of Europe's future industrial competitiveness.

Co-innovation and 5G testbeds accelerate the journey to Industry 4.0

The 5G smart factory trial[1] had the goal to build the Smart Factory concept and to test advanced technologies behind Industry 4.0. As a joint project by Mobile World Capital, Gestamp and Telefónica, this innovation builds on multi-sector cooperation in a 5G testbed context. It was a pioneering experience for both Gestamp and Telefónica, not to mention a technological challenge, as the technologies used were in their infancy in 2019 (5G, Edge Cloud -MEC, IoT, AI simulation, Digital Twin).

Telefónica has launched several clusters and testbeds across Europe to innovate in 5G technologies and test applications and processes, collaborating with industries, businesses, and governments to unleash the potential of 5G. These trials and testbeds are the basis of co-innovation with different sectors in early stages of the technology, accelerating innovative use cases and applications from the lab to the market. Examples, include the Nokia-Telefónica "Early 5G Innovation Cluster" in Germany[2] for testing first 5G services in a dense urban area; or Telefonica's public call in the UK[3] for companies to join early trials of 5G technology, both in 2018. In Spain, which is also a European leader in 5G trials, key initiatives are Telefónica's 5G ecosystem with more than 80 innovation trials and use cases and the 5GTonic Innovation Hub founded by Telefónica and IMDEA Institute, a public-private open research, innovation, and co-creation laboratory focusing on 5G.

The project entailed testing different innovative technologies and processes, to bring 5G use cases from the lab to the market. We achieved a first demonstration of a digital factory based

1 5G: The technology behind Industry 4.0. Video: https://www.youtube.com/watch?v=i-bSKA4Evz4

2 Nokia and Telefónica Germany built up joint "Early 5G Innovation Cluster" in Berlin (2018): https://www.telefonica.de/news/press-releases-telefonica-germany/2018/12/nokia-and-telefonica-germany-built-up-joint-early-5g-innovation-cluster-in-berlin-new-cellular-sites-will-enable-developing-and-testing-new-5g-services.html

3 O2 UK offers 5G Testbed opportunity to every company in the FTSE 100 (2018) https://news.virginmediao2.co.uk/archive/o2-offers-5g-testbed-opportunity-to-every-company-in-the-ftse-100-in-a-pioneering-move-to-improve-national-output-and-boost-the-economy/

on 5G coverage with public network and Edge Computing solutions, obtaining low latencies and improving performances. This was a preliminary step towards an industrial private 5G network, a solution now offered by Telefónica. We also tested the first 5G router equipment and devices.

Moreover – as a big step towards Industry 4.0 – we optimised and automated manufacturing processes, including with artificial intelligence-based support tools and digital twin environment, testing and improving solutions according to customers' needs.

How to launch a 5G testbed?

As in most of the 5G innovative use cases, this project too was born within a small, dedicated group within Telefónica, leveraging our large organisation's knowledge and resources, but agile enough to apply learnings fast. In this case, we have not used any public funding, which other Telefónica's 5G trials have benefited from. Our public call for proposals attracted the interest of several companies in different 5G trials. Linking the supply and demand side was key to optimising the development and commercialisation of the solution. Listening to customers' needs instead of presuming to already understand them, is key for successful co-innovation.

Making 5G work is bigger than just our business interest. We have posted the results of all trials to help other companies from different sectors understand how 5G innovations may apply to them and how to accelerate their digital and green transformation, boosting competitiveness.

Public sector involvement and regulatory adaptation will be key

This collaboration to test and incentivise new technologies development and adoption is an excellent example of how public institutions can help innovation become a key success factor.

To bring innovation from the lab to the market two aspects are essential:

First, an innovation-friendly framework that allows for "out of the box" initiatives and provides business models with legal certainty. The regulatory framework needs to enable technological innovation and remove regulatory hurdles to this process.

Second, accelerating time-to-market is just as important for innovation as supporting research. Concretely this means incentivising and funding testbeds and sandboxes for testing innovative technology solutions and new business models, as well as supporting the scale up of key technology-based projects, for example by rewarding cross-sectoral cooperation.

Looking at the basics, it is obvious that our industries can only transform if our society invests in STEM education to create the necessary expertise and skills. Moreover, for a strong skills pool, we need to retain European talent and attract external talent. Here we need governments to send clear signals (such as European visas to facilitate entrepreneurship or tax incentives for individuals).

In short to keep Europe as an innovation powerhouse, we need to walk the talk when it comes to testing new concepts in a real-life environment. We have to embrace that innovation is learning by doing and promote this however we can.

Patrick Pouyanné
Chairman of the Board and CEO
TotalEnergies

TotalEnergies

Climate change and circularity

Process

Cross fertilisation, internal research

Regulatory environment

Via new internal technological branch

Fueling energy transformation

Energy is fundamental for human life and progress. At the same time, energy is at the heart of the climate challenge: the production and use of energy are responsible for 70% of greenhouse gas (GHG) emissions. Meeting the climate challenge means taking on the energy transition and finding new production pathways.

We have to find new solutions especially for the transport segment, which contributes to 25% of the worldwide CO2 emissions. This is particularly true for aviation as electrification is not yet a possible option. A switch to Sustainable Aviation Fuels (SAF) is key: SAFs are recognised as reducing the CO2 emissions of the aviation industry by up to 80% if they were to replace fossil jet fuel completely.

Yet the feedstock quantities needed to produce sufficient SAFs are immense. If we look ahead up to 2050, replacing fossil aviation fuel by SAF would imply a worldwide production volume of 400 MT/year. The same volume is also forecasted in order to fully decarbonise the maritime sector by 2050. Already for 2030 we will have to reach ambitious targets set by the European Union and its main economical actors. For the coming decade, biofuels are the only solution available at large enough scale.

The prize questions are: Which feedstocks for biofuels are abundant, sustainable and circular? And how to reach the necessary scale based on today's infrastructure?

From fossil to biorefineries

To accelerate the transformation of our industry, TotalEnergies has created a new technological branch OneTech. OneTech brings internal technical and R&D teams together to design major industrial projects in all our energy types and provide innovative solutions while leveraging operational excellence. Bringing these experts together is instrumental in the transformation of our refineries into biorefineries and OneTech is a strong enabler.

TotalEnergies is already producing sustainable fuels after having transformed some refineries. In 2019, La Mede, TotalEnergies first bio-refinery, started to produce renewable road and aviation fuels by a steadily increasing share of animal fats and used cooking oils. The site is able to produce up to 500kt/y of biofuels.

A second site, Grandpuits, is currently being transformed into a zero crude platform including in particular, a biorefinery planned to start operations in 2025. The biorefinery will process 400 kt/year of feedstock, mainly animal fats and used cooking oils, and will produce 210 kt/yr of aviation biofuels, 50 kt/yr of renewable diesel and more than 70 kt/yr of bio naphtha/LPG.

We are also working on co-processing deployment in other refineries to rapidly ramp up biofuels production capacity. Notably, the TotalEnergies Normandy Platform has been producing SAF blended with fossil jet fuel since January 2022 by co-processing animal fats or used cooking oils together with fossil streams.

Solution for wider challenges · Type of innovation · Part of an EU / national initiative · Cross-sectoral innovation · Trigger

With these investments TotalEnergies is not only transforming its sites, but also preserving jobs in Europe.

A digital innovation model

All our biofuel production assets run in particular / almost exclusively on used cooking oils and other waste and residues – i.e. sustainable lipidic feedstocks (fats & greases) that neither directly nor indirectly compete with food and feed plants – and the quantities needed are ever increasing. Despite their clear advantages from a sustainability perspective, our choice of feedstocks also poses challenges – both in terms of access and of capability of processing them into high quality products such as Sustainable Aviation Fuel.

Our solution for the latter was to innovate our modeling approach and use a digital twin developed by OneTech.

This modelling tool is based on detailed analysis of feedstocks coupled with La Mede's industrial process data. It takes into account up to two thousand potential reactions occurring in the process. Based on the quality of available feedstocks, it allows process optimisation to maximise production and predict biofuel properties. This digital twin has been initially designed for La Mede processes, but the R&D teams are already working on a new version adapted to Grandpuits refinery and another one for coprocessing in other refineries like Normandy.

Ingenuity needs predictability

Our industry is adapting to the twin transition of decarbonisation and digitalisation – but also facing a twin challenge: We need to innovate and diversify feedstock and fuel production technologies at unprecedented scale and at the same time navigate an increasingly complex regulatory environment. Yet, how can we develop the best pathways for the best-fitted feedstocks, without a clear visibility on the regulatory framework?

Innovation needs predictability – for the current technologies as well as for new technologies beyond lipidic feedstocks. We are at the very beginning of a long innovation process and we need a clear perspective on the regulatory direction if we are to succeed in advancing and deploying new biofuel and e-fuel technologies. For example, if we develop processes to convert CO2/CO and Hydrogen or Alcohol to Jet fuel we need regulatory stability: All these technologies depend on the availability of specific feedstocks – and on the continued eligibility of these feedstocks under the European Renewable Energy Directive (RED).

The energy transition is a long game and requires long term investment – we can master most technological challenges, but only with clear and stable legislative perspective on where to focus our innovation efforts.

Thomas Leysen
Chairman of the
Supervisory Board
Umicore

umicore

Climate change, Circularity, resource scarcity

Process

(to a limited extent)

Customer demand, government demand

Transboundary shipments of batteries, funding, permitting

For recycling activities other than batteries

Recycling batteries – enabling e-mobility

The surge in electric mobility is both a huge opportunity and a enormous challenge for the mobility ecosystem. Nowhere is this truer than in the battery value chain. Demand for batteries will grow exponentially, but – on the flip side of the coin – it will be a struggle to source the large amounts of critical raw materials needed like nickel, cobalt and lithium. For the recycling industry, business will intensify too: over the next decade increasing numbers of Li-ion batteries from electric vehicles will reach their end-of-life, and significant amounts of production scrap from cell and battery cell manufacturing will be generated.

How well we will master the electrification challenge also depends on whether we can enable an efficient circular material model, i.e. whether we can innovate and industrialise sustainable battery recycling processes and industrial capabilities. The recycling of production scrap and end-of-life batteries extracts the valuable metals such as nickel, cobalt and lithium. They can be used again as building blocks for new cathode materials and reduce the need for adding “primary” critical raw materials extracted from mine concentrates.

Frontrunning in battery recycling

Europe is a cradle for the development of sustainable and efficient technologies. Based on Umicore’s extensive, pioneering experience of recycling precious metals from very complex materials including electronic waste, we have developed a unique battery recycling technology.

Umicore was an industry frontrunner with its investment in 2010 of an industrial demo installation (initial 7000 tonnes material input per year capacity) at its recycling plant in Hoboken near Antwerp, Belgium.

The technology implemented at Umicore combines a high-temperature treatment (pyrometallurgy) which melts the recyclables in a first process step, followed by a refining process step (hydrometallurgy) which extracts the valuable metals and brings them back in their pure forms so they can be used again for the manufacturing of new cathode materials.

Initial experimental work goes back to the early 2000’s when Umicore research teams were seeking demonstration of existing metallurgical competences on other feedstocks. As the number of Li-ion portable batteries was growing fast at that time especially in laptops, mobile phones and tablets, the aim was to recover first and foremost valuable metals like cobalt and lithium. This work resulted in building an industrial demonstration plant for recycling of batteries without the need for elaborated pre-treatment like discharging or dismantling.

Umicore received the European Business Award for the Environment (EBAE) in the ‘Process’ category in 2012. The majority of the innovation actions was funded by Umicore with some research grants achieved from the Flemish Government (Research & Innovation).

Technological success is not enough

In spite of this technological head-start on battery recycling technology, it has proven to be a challenging business environment. This is largely due to input shortages. The collection of end-of-life rechargeable batteries from electronic devices has not been successful, whether in Europe or globally, limiting the amount of materials available for recycling. Well-designed and enforceable regulation is needed to drive the collection of end-of-life rechargeable batteries from the automotive sector. Regulatory measures would help in guiding production waste and end-of-life materials to find their way to recycling facilities.

Even for a frontrunner, there is no static solution for high quality battery recycling. Since the design and composition of rechargeable batteries evolve, continued innovation is needed in recycling as well. It is here that another disconnect between the different parts of the value chain becomes painful: Innovation of batteries does not sufficiently incorporate eco-design principles and supply-chain thinking. Yet this is needed to make batteries really fit for a cost-efficient recycling – and it would allow the recycling industry to focus innovation efforts on further progress rather than on problem-fixing due to ever-changing design issues. Instead, today innovations in battery pack and cell design are solely focused on the first-use needs like the technical or safety performance of the battery, and too little on their suitability for dismantling and end-of-life recycling. Regulation can surely help shape the conditions to improve recyclability of the end-of-life batteries.

In short – when looking at innovation in a circular economy context – the whole value chain must be considered from cradle-to-grave in order to achieve real circularity that keeps valuable raw materials in the loop as long as possible.

Holistic policies set a sound foundation for innovation

Not only in the design of rechargeable batteries but also in the evaluation of battery recycling technologies, a holistic view is of key importance.

What is needed is a life cycle assessment approach. The correct comparison of different technologies from cradle-to-grave is key to understanding our choices and deciding what we need to improve via innovation. For instance, if the priority is to achieve the lowest impact on Greenhouse Gas emissions, a lifecycle assessment would point us to the right decisions and policies that design the reference framework for measuring such life cycle impacts should be rigorously implemented.

What does this mean for innovation more generally? In a circular ecosystem, if each part on the value chain operates and pursues innovation in isolation, this leads to suboptimal and conflicting outcomes. What we need is collaboration and a shared compass for innovation. For such a shared compass we need coherent political goals that set the direction of the various layers of regulation and supposedly 'small & and technical' details. Those 'small bits' play a big role in determining which innovation ultimately has a business case.

Jean-François
van Boxmeer
Chairman
Vodafone Group

vodafone

Digitalisation and tailored applications

Architecture (digital connectivity infrastructure)

✕

✓

General trends in IT/ICS technologies and computing

Political signalling, prevailing economic philosophies

✓ External partners

✓ For all digitizable industries

✕ (Mainly outside Europe, for now)

The jury is out...

Pushing doors open

In recent years, we have seen an unstoppable trend of software disruption across several industries. Radio networks, which are key for connectivity, are no exception. And yet, radio networks themselves have remained largely unchanged for decades.

Part of radio technology's global success in mobile communications was the way it traditionally worked with a small set of standard interfaces. However, for the most part, these technologies are built with proprietary components. As a result, innovation in radio has been constrained by the resources developed by a few incumbent suppliers.

Since 2018, a new approach has emerged: radio virtualisation alongside the ability to separate hardware and software on a multivendor, open radio access network, otherwise known as 'Open RAN'.

The Open RAN revolution

Open RAN implements the same interfaces and technologies as traditional RAN, but pushes the boundaries of technology to implement radio solutions based on standardised interfaces and common off-the-shelf hardware.

Vodafone is driving this technology, together with other major global operators, as members of the O-RAN ALLIANCE. Established in August 2018, the O-RAN ALLIANCE is a world-wide community of mobile network operators, vendors and research institutions.

Open RAN is no longer just an R&D initiative for mid-size suppliers of radio networks. Today, there is virtually no vendor in the IT and telecommunication sectors not exploring or supporting this exciting new innovation.

What are the benefits of Open RAN?

Commoditising radio platforms makes them cheaper over time. The open interface specifications from the O-RAN ALLIANCE enable previously unseen levels of modularity. This effectively removes entry barriers for new innovation-hungry companies and removes the risk of vendor lock-in.

Change in this space doesn't stop there. Vodafone's next focus is chipsets, where extending the concepts of open interfaces and increased modularity could improve Open RAN performance and costs. Silicon vendors currently use custom silicon which provides the performance required, but results in chipset lock-in.

To help tackle this, Vodafone has established the Malaga Open RAN Centre, an ambitious endeavour to guide the Open RAN chipset industry. Over time, with the right regulatory and funding support from governments, the centre could transform the industry by promoting a standard framework for multi-use chipsets, making them cheaper and partially programmable. This will allow for flexibility, innovation and competitive differentiation.

Another innovation is a new network architecture defined by the O-RAN ALLIANCE,

which includes the possibility of running applications at the edge of the mobile network. This is called the 'Radio Intelligent Controller' (RIC). The RIC presents another significant opportunity to develop new applications tailored to specific industries using Open RAN. RIC applications will incentivise software companies to enter this previously walled garden.

Unlocking opportunities

Within the EU, both political signalling and uncertainty about concepts such as 'open strategic autonomy' or 'digital sovereignty' are having a dampening effect. Open RAN must be part of the EU's vision for digitalisation – without this, the EU risks deterring European players from entering the market or future-proofing their positions.

The US is looking to support the accelerated development of Open RAN and prove the technology at scale. If a gap opens between US-sponsored efforts and progress on Open RAN elsewhere, US technology companies could establish a commercial lead.

To avoid this, we need clear signals from the European Commission. Open RAN could become part of Europe's digital transition; from supporting start-ups to enabling SMEs, forging industrial alliances and building large scale pilots. It could lead to transformative projects across Europe.

Open RAN, whilst primarily a telecommunications issue, touches on the wider question of whether open strategic autonomy helps or hinders European innovation. Open RAN is an example of how political will and messaging ultimately decide where, rather than if, innovation happens and who becomes a leader or laggard. If Europe wants to play a role, it must be now.

Martin Lundstedt
President & CEO
Volvo Group

VOLVO

- Climate change
- Product, ecosystems and infrastructure
- ✕
- ✓
- Urgent societal need
- Funding, including from public sector, to promote market scale-up
- ✓ Multiple external partners
- ✓ Across several sectors
- ✓ Conditional on government support
- 👍

California dreamin': From innovation to deployment

Electrified heavy transport will help to reduce CO2 emissions and improve air quality in our cities. This is a great goal, and so are the challenges, both in terms of technical innovation and of deployment.

Europe rightly takes pride in its vanguard role in the green transition – yet it is the US where pioneering the electrification of heavy transport takes place at scale.

In 2019, as demand for goods in the US continued to reach record highs – with more than 70% of all goods transported via trucks – the nation's cities were facing an increase in congestion, noise and air pollution. No single entity could unilaterally solve this societal challenge. This was the starting point for a pioneering partnership between government bodies, manufacturers and funding institutions to design a blueprint for the introduction of zero-tailpipe emission trucks and equipment into the market at scale. What was not anticipated was just how quickly transformational results would be delivered.

Pioneering together with public entities in the US – a success story

Volvo LIGHTS (Low Impact Green Heavy Transport Solutions) was a three-year partnership between us at Volvo Group, California's South Coast Air Quality Management District (AQMD), and 12 other organisations.

The project was made possible by a $44.8 million award as part of California Climate Investments (CCI), one of the most effective public funding systems in the world. In addition, through substantial match funding, California has awarded five other zero-emission truck and infrastructure projects with focus on implementation.

Thanks to the transparency, creative thinking and collaborative approach of all partners, the Volvo LIGHTS project delivered definitive results in the important areas of vehicle technology, charging infrastructure and sales and service support. All three areas are vital for the successful deployment of sustainable transport solutions:

First, getting new truck models to market: the introduction of zero-tailpipe emission Class 8 Volvo VNR Electric trucks to Southern Californian fleets led to a speedy introduction to the US market (December 2020). It also proved the point that that heavy-duty battery electric vehicles offer considerable lifecycle emission reduction benefits – 65% in total energy, 81% in fossil energy and more than 80% reduction in greenhouse gas emissions.

Second, creating the right infrastructure to power trucks: the installation of private network charging stations for trucks by Shell Recharge Solutions provided average and high-powered DC fast chargers which integrated with Volvo's

truck telematics to balance the needs of vehicles, facility and utility grid.

Third, spreading skills to maintain our trucks: Never forget the human element – setting up programs to train heavy-duty electric truck technicians through Rio Hondo College and San Bernardino Valley Community College was key, as was the establishment of the Volvo Trucks Certified EV Dealer program to help fleets achieve their zero-emission transportation goals and ensure maximum vehicle uptime.

Global change via the California model

With political will, the California partnership model can be replicated across the world and help deliver the rapid and transformational change needed to meet our climate goals. Key ingredients for this recipe are a) the collaborative approach of all parties and b) the ability of the funding system to quickly and efficiently lay the foundation for a cohesive exploration into sustainable technologies.

As a world leading manufacturer of trucks, buses, construction equipment and marine and industrial engines across 190 markets and four continents, we understand the complexities – and benefits – of research and innovation. We also have the advantage of comparing regional innovation systems. One insight is that market adoption of new truck types – and therefore impactful change – is more feasible in countries with more deployment-focused, progressive funding projects.

Can Europe be next?

For Europe to move to electrified heavy duty transport, EU-level and national policymakers should urgently assess how to learn from the California approach and how to replicate it in a European setting. Promoting innovation and achieving immediate market scale-up are key – and we have to be especially mindful to avoid silo-thinking during the execution phase.

Our message to EU research & innovation funding institutions is simple: let us work in partnership to make market scale-up a tangible commercial success for the benefit of all of Europe. For this the EU needs to ensure that state-aid rules can accommodate seamless support for a scale-up of successful innovation results and their effective deployment. Our current means are too limited, even if we already see several promising partnerships in the EU like REEL, a Swedish initiative where leading players have joined forces to accelerate the transition to electrified emission-free heavy transport on our roads.

For the EU to succeed as a global leader in delivering sustainable growth and braving the climate challenge, we need to look beyond our borders for best practice examples. If we are truly making the deployment of R&I results our priority, then EU state aid rules must shake off the traditional way of thinking because it stands in the way of future competitiveness and large-scale innovation.

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