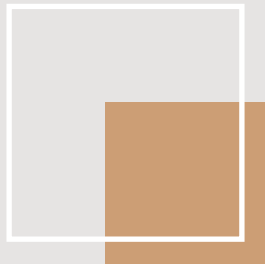




GREEN AND SUSTAINABLE MOBILITY IN SOUTHERN GERMANY



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GREEN AND SUSTAINABLE MOBILITY OF THE FUTURE: COLLABORATION OPPORTUNITIES WITH SOUTHERN GERMANY

Southern Germany (Bavaria and Baden-Württemberg) is the motor when it comes to research and innovation within mobility in Germany. However, how does it look when we take into consideration the SDG's and the "Green Agenda"? Germany is among the most emitting countries in the world and manufacturing more cars does not necessarily mean a more sustainable world.

Sustainability and SDGs are neither talk of the town nor necessarily key part of the branding of German companies. However, the industrial transformation requires German companies and research institutions to move in a green direction.

With this Outlook, we aim to bring successful green partnerships from German research and industry out in the light. Furthermore, with the highlighted cases, we wish to connect Danish and German innovation environments in future mobility even closer.

The innovation landscape can be segmented into the following groups:

- The established players, such as industrial giants like BMW and MAN
- The challengers: New technology companies on the rise such as Lilium, developing flying taxis

- The bright minds: Researchers at leading technical universities, such Technical University of Munich (TUM), Stuttgart University and Karlsruhe Institute of Technology, teaming up with industry in research and innovation campuses.
- The young entrepreneurs and talents, who unfold their talents at the new innovation space Munich Urban co-Lab as well as when students from TUM win the international Hyperloop competition for the fourth year in a row.

At Innovation Centre Denmark in Munich, we work to bring you in contact with excellent players from all four groups. We do this in an effort to connect Denmark with one of the world's leading innovation ecosystems. In 2021, we will sharpen our focus on sustainable green partnerships. A key element in this is our tech scouting platform, which you can read about on the next pages.

We wish you happy reading and look forward to hearing from you.

Innovation Centre Denmark in Munich



THE LIFEBLOOD OF THE GERMAN ECONOMY



Photocredit: Unsplash

Around 10 years ago, Chancellor Angela Merkel made waves for claiming that one in seven Germans is either “directly or indirectly” linked to the automotive sector. While there may be

more than a touch of exaggeration in her remark, the German automotive industry is an international powerhouse. Not only does the industry account for over 25 per cent of Europe’s total sales of passenger cars, they export approximately 3.5 of the 4.6 million cars manufactured each year.

Germany’s automobile sector is home to some of the world’s biggest and best-known names, from Volkswagen to high-end manufacturers like BMW and Daimler/Mercedes-Benz. But it also includes some of the world’s leading parts suppliers – namely original equipment manufacturers, such as Bosch and Continental, as well as a myriad of small and medium-sized enterprises along the value chain. These are the so-called ‘hidden champions’ of the German economy.

According to the latest research issued by the economic development agency, Germany Trade & Invest, the auto sector listed a turnover of EUR 435.3 billion – around 20 per cent of Germany’s total industry revenue. Indeed, this global market leader constitutes the very backbone of the German economy.

Yet, the industry is driving not only wealth, but also urbanization, increased rates of car pollution, and congestion. The challenges are piling up for the automotive industry, and there is a great need to address them through technological solutions. Electric mobility is far cleaner than oil and gas; car sharing promises

to decrease the number of vehicles in use worldwide; and autonomous driving will help to boost the capacity of streets – whether in urban centres or highways.

Since the southern regions of Baden-Württemberg and Bavaria are leaders in high tech and mechanical engineering, investment into research and innovation is greater here than any other part of Germany*. To that end, the federal government allocates a quarter billion euros annually to research and development that’s aimed at transforming the

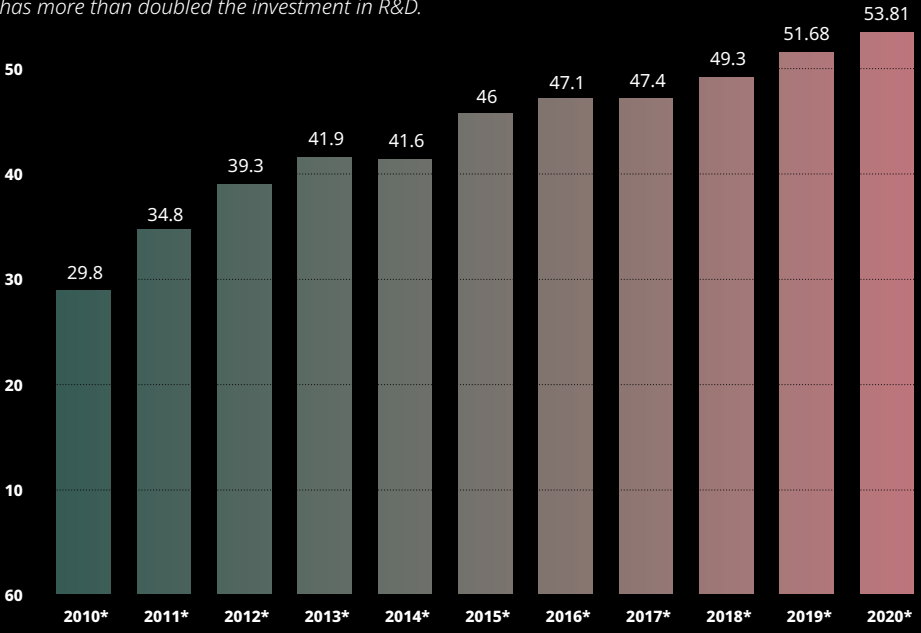
industry to e-mobility (Germany Trade & Invest). Much of the work is being done in battery technology and recycling.

Driving Innovation

The automotive industry is undergoing a period of radical transformation – from the development of electric vehicles, alternative fuels, growing urbanization, and the rise of car sharing to meeting the needs and preferences of younger generations. All the while, the global demand for mobility is increasing.

Expenditure on innovation in billions euros

Germany is Europe’s leading production and sales market the profits allow for the companies to invest heavily in R&D. Over the last ten years German automobile industry has more than doubled the investment in R&D.



Source: Germany Trade and Invest

* Source: <https://www.fdiintelligence.com/article/75469>

Electric vehicles in 2020

200.000

2022 forecast:
1.000.000

Public charging infrastructure in 2020

DC Charging

1.400

2022 forecast:
7.100

AC Charging

7.900

2022 forecast:
70.000

Source: Germany Trade and Invest

The United Nations anticipates that the world population will increase from 7.8 to 9.7 billion by 2050. Urbanization is expected to reach 68 per cent by 2050, versus 55 per cent today. And the number of people who can afford a personal vehicle is ever-increasing. As a result, the global fleet of light vehicles is expected to grow from 1.2 to 1.6 billion by 2040.

Of course, urban growth is tied to the three dimensions of sustainable development, namely: economic, social, and environmental. Well-managed urbanisation, informed by an understanding of population trends over the long run, can help to maximize the benefits of agglomeration while minimizing environmental degradation and other potential adverse impacts of a growing number of city dwellers.

Sustainable Mobility

The future of mobility extends far beyond the automotive industry. It includes general infrastructure

for scooters, trains, and trams – and perhaps even airborne urban mobility.

Without question, mobility is essential for both people and goods. This outlook offers a deep dive into how the German automotive industry is applying new technologies and new business models to make mobility sustainable, more broadly accessible, and integrated into a multimodal ecosystem for higher overall efficiency. We also investigate how collaboration across public and private players, and alongside citizens, is required now more than ever before to develop sustainable mobility by the people for the people.



Photocredit: Unsplash

Facts box:

'Hidden champions' is a term coined by Hermann Simon to refer to companies that are among the top three in the world market, but have a sales volume of less than five billion euros, and are little known to the general public.

TECH SCOUTING

Take advantage of Innovation Centre Denmark's global advisory network and local experts for finding the right technology solutions for your organization. Our Tech Scouting Program is global, neutral, data-driven and offers a unique advantage of local networks and expertise.

In the race to innovate, DAX companies are moving away from accelerators to Corporate Venture Capital (CVCs) and Startup Partnering. Startup collaboration involving pilots and proof-of-concept projects have become increasingly important. Innovation managers are receiving direct challenges from the internal business units. This demand for tech innovation is fulfilled by internal and external technology scouts who reach out in their networks looking for solutions. Finding the perfect hand-picked technology solution is a resource-intensive task. Moreover, finding the right regional hidden champions often requires a deeper on-ground network. While Munich is emerging as the startup collaboration and corporate venture client hub, Berlin is maintaining its ground in the field of classic venture capital investments.

The shift from being an "Automobile Nation" to alternative visions of mobility has remodeled the innovation ecosystem in Germany along with the co-development of adjacent industries. Corporates are struggling to innovate and find greener technologies. Tapping into this growing demand for technology sourcing coupled with the growing trend of startup collaboration in Germany presents a unique opportunity for ICDK. By leveraging its global network of advisors and experts

from the Danish and German innovation ecosystems, ICDK can generate unique value by bridging the technology scouting gap.

Germany is one of the most important commercial and research partners for Denmark. This is a prelude to ICDK, Munich emerging as an important strategic





NEUTRAL & TRUSTWORTHY

Our diplomatic position and partnerships with universities, co-working spaces, accelerators, local startup communities and incubators both in southern Germany and globally helps us to find the best-fitting technology solutions for you.



DATA-DRIVEN

We leverage the power of local and global databases, to make sure we cover every corner of the market. We top this with human expertise to ensure that no technologies slip away from our scouting process.



LOCAL EXPERTISE

We have boots on the ground in Southern Germany as well as in the global innovation hotspots like Silicon Valley, Tel Aviv, Shanghai. We make it our business to know what's going on and where to find the next cutting-edge tech you are looking for.



GLOBAL NETWORK

We rely on a solid network of technology and business experts, decision makers, marketers, investors, startup founders and entrepreneurs who point us in the right direction. This enables us to forge the right connections by matching decision-makers within organizations.

centre. By building a network with corporate innovation managers in Munich, investors in Berlin and research collaborators across public-private institutions, ICDK will be able to bring knowledge about both commercial and research innovation back home. Furthermore, tech scouting will allow us to establish long-term collaborations with the stakeholders, strengthening our roots in Southern Germany.

The Service

Southern Germany, one of Europe's strongest technology regions, has a thriving and transforming innovation ecosystem with global players like BMW, Siemens, Audi, and entrepreneurial talents from the world's leading technical universities. The Innovation Centre Denmark in Munich with its strategic presence can tap into this unique regional ecosystem, leverage the innovation ecosystem in Denmark to help your organization find the right technology solutions.

Our Tech Scouting service involves matchmaking activities and is driven by the tech innovation needs

within corporates in Germany and Denmark. As a part of the service, we help our German Corporate and investment partners find technology solutions from Denmark. Reciprocally, we match the Danish corporate counterparts looking for solutions with the technologies from Germany.



ICDK's location in innovation hot spots like Silicon Valley, Tel Aviv, Seoul, and Shanghai enables us in Munich to tap into a huge innovation and expert network to find the right solutions. The tech advisory team in Munich adds on a unique knowledge of the local innovation ecosystem in Germany. Our unique positioning as a neutral party without vested interests enables us to get access to decision-makers within companies and research institutions. Moreover, our diplomatic positioning enables us to forge trustworthiness in the partnerships we build in the region.



At BMW, we always look for smart and innovative solutions that can improve our production and logistics. Therefore, it does not matter whether these ideas come from large companies or start-ups. However, it is a lot harder to keep track of the countless start-ups, compared to the established large companies. That is why we are constantly building on our relationships with universities and start-up centres, which is why we also knew that Innovation Centre Denmark would be the right partner for us.

Marco Prueglmeier, Project leader at BMW

THE PROCESS

01

IDENTIFYING YOUR PROBLEMS

We engage with your organization to first and foremost understand your needs. By identifying and working with the right stakeholders within your organization, we will gauge the problem you are trying to solve in the value chain to find the right technologies.

02

CO-DEVELOPING SCOUTING STRATEGY

Based on our findings and ideas from discussion with you, we assess the market together and formulate a scouting strategy to search, filter and shortlist technologies. This will ensure that we deliver your satisfaction with best fitting technologies and outcomes.

03

LEVERAGING OUR NETWORK

Based on the scouting strategy, we leverage our partnership and extended network and crunch the data we collect. As we deep-dive into our findings we combine databases with human intelligence to make sense of the data and to identify the best fit to your needs.

04

DELIVERING TECHNOLOGY SOLUTIONS

We compile our findings into actionable insights for you. Based on the specific case and your needs, we will either set up 1:1 meetings with relevant parties or organize a tech scouting event involving showcase of technologies.



SOUTHERN GERMANY AS A HOTSPOT FOR GREEN INNOVATION

GREENCITY.DE

Location: Munchen

The Munich-based organisation 'Green City' is accelerating green change by ensuring all stakeholders are on the same page talking the same language.
Read more on page: **29**

INNOVATIONS CAMPUS FUTURE MOBILITY

Location: Stuttgart

Innovations Campus Future Mobility aims at producing new and pioneering technology by excellent fundamental research in the fields of mobility and production.
Read more on page: **24**

DEUTSCHE BAHN

Deutsche Bahn aims to become a climate-neutral company by 2050 and are testing hydrogen trains in Tübingen with the support of Baden-Württemberg's Ministry of Transport.
Read more on page: **23**

SHARED HYDROGEN CAMPUS

Location: Nuremberg

MAN Truck & Bus have joined forces with Nuremberg Universities at their plant in a joint effort to co-develop the hydrogen technologies for the future of mobility.
Read more on page: **18**

BMW PLANT LEIPZIG

Location: Leipzig

The BMW Leipzig Plant is among the most modern car production facilities in the world. With its "Green Plant"-project it aims to become carbon-free; reducing the CO₂-footprint on cars before they even leave the facility.
Read more on page: **21**

LUDWIG BÖLKOW CAMPUS

Location: Taufkirchen

With 'Aerospace Valley' the state of Bavaria is positioning itself to stay a leader in the aerospace industry through the green transformation. With the Ludwig Bölkow Campus, the region's many prominent aerospace players have been tied together in new ways.
Read more on page: **27**

TUM HYPERLOOP

Location: Munich

The university-backed Hyperloop-project from TUM is a global leader in its field - speeding up the journey to a sustainable future.
Read more on page: **12**

LILIUM

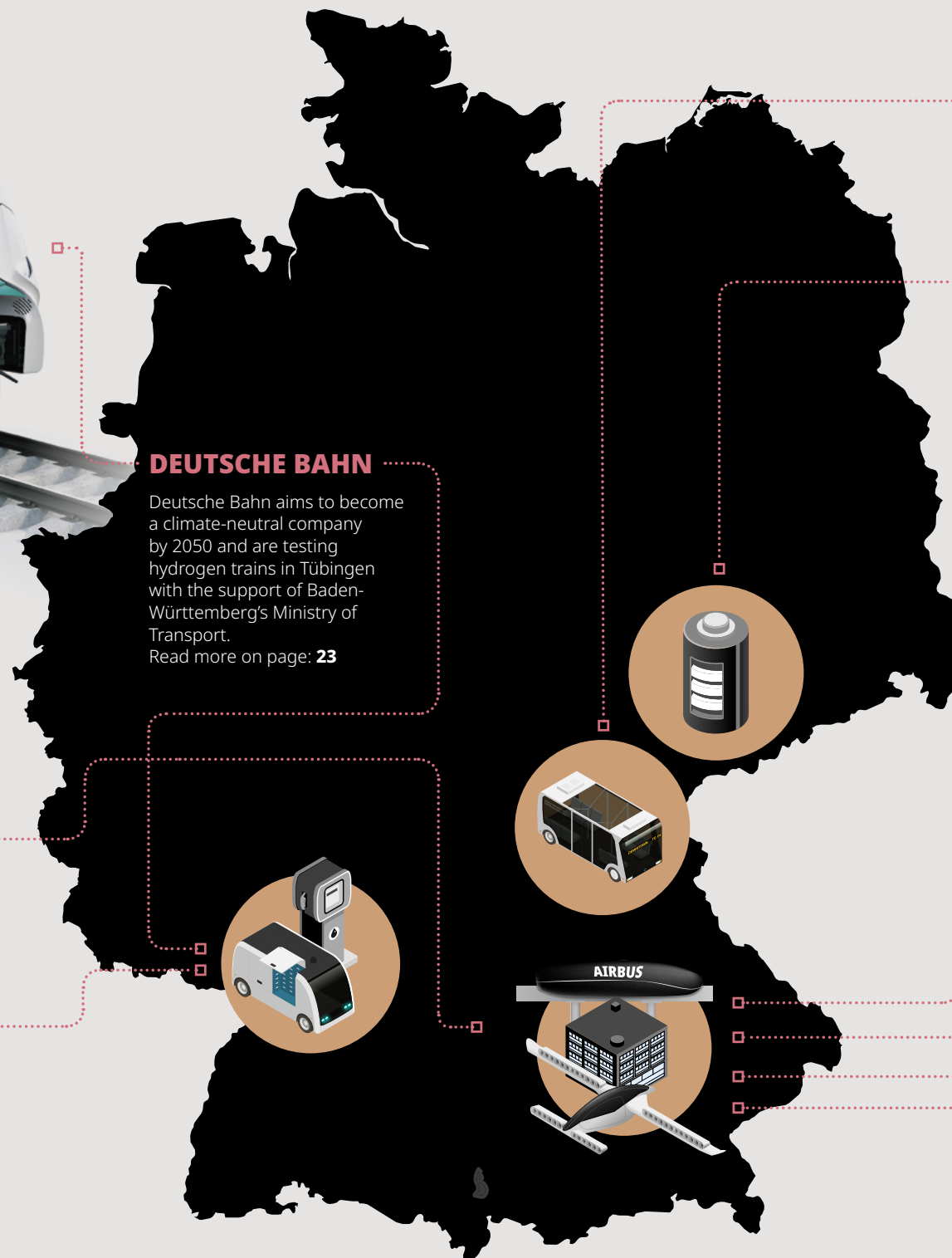
Location: Weßling, Germany

All-electric regional air mobility pioneer aiming to connect European cities with sustainable air transportation by 2025.
Read more on page: **12**

MUNICH URBAN COLAB

Location: Munich

The Munich Urban Colab will uniquely bring together corporates, creatives, startups and the state of Bavaria to develop solutions to meet the challenges of our metropolises.
Read more on page: **15**





THE FUTURE OF MOBILITY IS FAST, GREEN, AND HERE TO STAY

Worldwide, teams of students, professors, and industry leaders are working together to develop vacuum-sealed trains and flying, electric taxis. Chief among them, Germany’s emerging leaders are coming up with solutions to offer electric-powered, sustainable, and environmentally-friendly forms of transportation.

The future of transportation is here, and it has taken the form of high-speed trains in vacuum-sealed tubes. While the idea behind this transportation system emerged in 2013, with Elon Musk and SpaceX, a team of students from Munich are developing their version.

From its humble beginnings as a student-run organisation at the Technical University of Munich (TUM), a team of engineers began participating in the worldwide Hyperloop competition in 2015, and eventually won the main prize for creating the fastest pod on the test track. In the last years, the team has managed to set new records and come out on top.

According to the project lead, Gabriele Semino, TUM Hyperloop has attracted close to 60 corporate partners, experts in the field, and 70 students (from 28 countries). This past year, the university announced that the project would be transitioning from student-run to a research group backed by the Bavarian government’s Hightech Agenda Bayern. The next step will involve a full-scale prototype of the pod running on a 24-meter track at Ludwig Bölkow Campus in Taufkirchen.

Clean and Efficient

Since trains are already the best form of transportation in terms of energy consumption, Semino predicts that the technology behind Hyperloop will have a transformative impact on the sustainable transportation industry:

“Preliminary calculations suggest that Hyperloop will be even better than traditional trains while travelling at speeds comparable to planes.”

On a deeper level, TUM Hyperloop is a prime example of the type of collaboration that the European Union



TUM Hyperloop started as a student-run project in 2015, and has since grown into one of the university’s official research programmes. Currently, 5 doctoral students are involved (which will grow to 9 during 2021), and they are working alongside 70 students, and a group of professors on a curricular as well as informal basis.

needs to encourage to reduce transit-related greenhouse gas emissions by 90% by 2050, as part of the European Green Deal. While Hyperloop is still in the development stage, the technology is already viable – though it needs to be economically appealing to be implemented. Semino explains:

“These solutions must not only be financially competitive with the existing options, the will and funding to actually implement them have to be there. Hyperloop is a large-scale infrastructure project and

there is a lot of expertise, cross-disciplinary input, and development required before it can be built. So, even in the development phase, we have to focus on what's commercially viable. If the system isn't competitive with current solutions, it won't be built. The focus has to be on long-term scalability and commercialisation".

Airborne and green mobility

Germany has been a pioneer in transportation for over a century – most notably in the automotive industry. There is every reason to believe that the nation will also play a significant role in the future of mobility.

While vacuum-sealed trains and flying taxis might sound like something out of a futurist's dream, both are being turned into reality in southern Germany. Lilium is developing the fully electric commuter plane, Lilium Jet, which will be capable of shuttling passengers between towns as easily as ordering an Uber, not to mention taking off and landing vertically.

Back in 2019 Daniel Wiegand, the co-founder and CEO of Lilium, presented their newest full-sized prototype. Without mincing words, he announced: "We promised the world a 5-seater jet. Today we are delivering on that promise."

• *If the system isn't competitive with current solutions, it won't be built. The focus has to be on long-term scalability and commercialisation*

Gabriele Semino, project lead, TUM Hyperloop



Like many other tech start-ups, the organisation's 4 co-founders met while studying at the Technical University of Munich and quickly became interested in what Matthias Meiner refers to as "an air mobility revolution."

TUM Hyperloop and Lilium each have a vision of a faster, greener, and more convenient future for travellers. Not only is Lilium's jet fully electric and once it's airborne it can boast a range of 300 kilometres. Lilium's vision is to transport commuters between cities as soon as 2025, and autonomous flights are slated to follow soon after.

In a time when urbanisation is rapidly changing the way we live and design cities, the mobility revolution and transportation alternatives developed by Hyperloop and Lilium offer exciting possibilities for people who want to live in rural areas yet desire a taste of fast-paced big city living. If cars are no longer the primary mode of transportation in the future, traffic density and air pollution will decrease, and entire countries could see a return to people moving back into rural areas.



**MUNICH
URBAN
COLAB:
ASSEMBLING A
EUROPEAN POWER-
HOUSE COLLABORA-
TING ON SUSTAINABLE
URBAN INNOVATION**

The global population is rapidly moving to cities. By bringing together startups, corporates, universities and government under one roof, Munich Urban Colab wants to ensure liveable and sustainable urbanization.

Today, five out of every 10 people worldwide already live in a city. And by mid-century, this number is estimated to increase to seven out of 10, according to the United Nations.

Fast-paced urbanization raises a series of challenges: How can growing cities be sustainably supplied with energy, water, and products? How will waste be disposed of and the air kept clean? And how will green mobility be guaranteed?

To address UnternehmerTUM and the City of Munich have launched the initiative Munich Urban Colab. Currently, an 11.000 square meters powerhouse is being constructed in Munich's creative district with a vision to become Europe's leading hub for smart cities.

Sabine Hansky, Chief Communications Officer at UnternehmenTUM explains:

"At Munich Urban Colab corporates, entrepreneurs, scientists, architects, creators and talents are brought together to collaborate with the capital of Munich. This presents a very unique opportunity for decisionmakers to meet across entities as the will all be under one roof."

A powerhouse for all stakeholders

Rapid urbanization calls for swift development of new, innovative solutions. This can only happen efficiently if the different entities are working together. "All of this has enormous economic potential for companies. And the Munich Urban Colab offers a unique environment that brings together the worlds of business, science and administration to foster the development and piloting of new products and services as well as the establishment of a dialogue with the public," Hansky says.



If a startup is developing an intelligent traffic management system to ensure a liveable city and promote greener mobility, they meet all relevant stakeholders inside Munich Urban Colab. The startups can partner up with universities for research in data management, produce its solution in cooperation with a corporate partner, and then sell it to and implement it alongside the state.

The different parties currently work in tandem, but the mission is to accelerate collaboration while focusing on people. As Hansky puts it:

"It will be very interdisciplinary, and we will have all the topics for a liveable smart city on the agenda. The smart city is not necessarily equal to a liveable city. So for us, it's important that the 'Colab' put people into the equation and into everything we do. We believe that the need and challenges of people are our primary concern."

Global ambitions for global challenges

The vision of becoming a smart cities global hotspot is ambitious, yet Munich Urban Colab knows it is attainable. Supported by prominent stakeholders, Munich Urban Colab is significant even before the doors have opened. In Hanskys words:

You can develop and grow a solution faster within a community that offers partners, investors and talent for growth

Sabine Hansky

"Munch Urban Colab should be interesting for all companies and startups working on smart city solutions. We offer workspace and living labs, but the main unique selling point is access to a highly innovative community across industries. And of course, that is also interesting for Danish companies."

The aim is to develop international solutions for global challenges in urbanization, and Munich Urban Colab also invites Danish startups and corporates to participate.

"The vision is to become the hub for smart city solutions. You don't have to go out to Silicon Valley—Munich is nearer. And of course, you can develop and grow a solution faster within a community that



offers partners, investors and talent for growth. You find all the ingredients you need for a successful company and the growth in one place," Hansky says.

Munich Urban Colab—an initiative of UnternehmerTUM and the City of Munich:

- A 11,000 square meter urban innovation hub dedicated to facilitate networking between talents, startups, corporates, Bavaria's state capital Munich and its citizens: to harness technology and entrepreneurial power for developing and implementing sustainable, internationally scalable solutions for the city of the future.
- Brings together the state (City of Munich), the corporate world (startups and corporate partner) and educational institutions (like Technische Universität München).
- Strong partners from the beginning, including Aachener Grund, BMW, Infineon, KPMG, Wacker, SAP, etc.
- The focal point is collaboration—and Danish startups and corporations are invited to join as well.

Facts: Join the Colab

- Everyone can join the co-working space at Munich Urban Colab, including Danish startups.
- By joining Munich Urban Colab, you will get first-hand access to top-researchers, the best tech-startups in the space, global corporations, and representatives from the State of Bavaria in order to directly implement urban solutions. Other benefits include a high-tech-factory, MakerSpace.



Andreas Tostmann (CEO of MAN Truck & Bus SE), Prof. Dr. Joachim Hornegger, President of the Friedrich-Alexander Universität Erlangen-Nürnberg, Prof. Dr. Niels Oberbeck, President of the Nuremberg Tech, Dr. Markus Söder, Bavarian Prime Minister, and Saki Stimoniaris, Chairman of the MAN Group Works Council (from left to right) met at the MAN site in Nuremberg to sign the cooperation agreement.

FROM DIESEL TO HYDROGEN

MAN Truck & Bus was integral to inventing the diesel engine a century ago. Now, the company is preparing for the next revolution in freight transport by investing in electrical vehicles and hydrogen.

A wave of electrification has hit private motoring, but the freight industry hasn't yet been affected to the same extent. As customers call for greener transportation of their goods, the pressure for electric trucks is increasing, and more manufacturers are pushing new electric models to the market to meet this demand.

MAN Truck & Bus are among those manufacturers. The company supported Rudolf Diesel in inventing the self-ignition diesel engine at the beginning of the twentieth century, and now the company is preparing for the next revolution: they have confirmed both electrical and hydrogen models in the future to help the freight industry switch to zero emissions.

Andreas Bug, Engineering Powertrain Strategy, MAN Truck & Bus SE explains:

“The DNA of MAN is always looking for new solutions. Although the diesel engine was developed with support from MAN, we're eager to go into new technologies. We already started hydrogen in the '90s, and now we are looking ahead in that area on a larger scale.”

A shared campus for hydrogen research

Back in the '90s, MAN was pioneering hydrogen-powered busses around Germany. The project showed that the technology worked and was quite reliable.

“We had hydrogen busses close to the airport of Munich and a demo-fleet in Berlin, and they did a really good job. In those days, the demand for hydrogen

There is a wide demand for hydrogen, especially in the heavy industries in Germany. Higher demand will eventually make prices drop—and then it becomes interesting to use hydrogen for trucks

Andreas Bug

in public transportation was there, and some of the vehicles ran quite successfully until 2014. But they had to be subsidized by the public, and when the programs ran out of funding the high prices of hydrogen made it stop,” Bug shares.

With a global renewed ambition for zero-emission solutions, the company invests in hydrogen—among other things—by announcing their ‘Shared Hydrogen Campus’ alongside Nurnberg Universities Friedrich-Alexander Universität Erlangen-Nürnberg (FAU) and Nuremberg Tech (THN). Bug explains:

“We are already quite experienced in hydrogen, and last year and this year we really jumped back onto that track. We have now launched the hydrogen campus, which is aimed at bringing all the knowledge in the area together in order to drive hydrogen forward.”

The campus is located at the MAN plant in Nurnberg where all parties collaborate on joint research. The idea is to eliminate distance between the partners during research and development. So far, Covid has challenged that vision, but the hope is that technological



MAN Bus & Trucks believes the future will be both electrical and hydrogen. The technologies each have their advantages when it comes to efficiency, range, weight and fuel/recharge time.

advances in hydrogen will allow the industry to begin pulling the big lever for the technology: price.

The future needs scale

There is still research to be done before hydrogen vehicles are ready for mainstream adoption, which is what MAN and the collaborating universities is contributing to through 'Shared Hydrogen Campus'. But in addition to more research, the success of the technology also depends on scale, Bug explains:

Shared Hydrogen Campus

- Man Trucks & Bus, Friedrich-Alexander Universität Erlangen-Nürnberg (FAU) and Nuremberg Tech (THN) have signed a cooperation agreement on the research and development of hydrogen-based vehicle drive systems in what is called 'Shared Hydrogen Campus'.
- The Campus is located at the vehicle manufacturer's plant in Nuremberg, where university academics and students are running a laboratory and test rig.
- The work taking place at the Hydrogen Campus will span the entire value chain of this type of drive system: from eco-friendly hydrogen generation through distribution, infrastructure, and converting it back into electricity all the way to technology application in customer vehicles.

"There is a wide demand for hydrogen, especially in the heavy industries in Germany. Higher demand will eventually make prices drop—and then it becomes interesting to use hydrogen for trucks."

However, MAN isn't just investing in hydrogen, but also battery-based electrical vehicles. They don't believe in a one-size-fits-all future. Different technologies have different advantages, which fundamentally challenges the manufacturers to bring the specific product to the customer that best suits their specific demands.

"In the diesel-age, one vehicle fits everyone. There's a big change in the industry in front of us. We need specific vehicles for specific demands, so we are betting on both technologies. There is no simple answer for the logistics of the future," he says.

Prototypes of the hydrogen vehicles are planned to be built as early as next year, while the company's all-electric heavy truck is set to hit the road by '23-'24, with production-ready hydrogen models following in the latter half of this decade.

But that is just the first step. In order to succeed, infrastructure has to be implemented and the price of hydrogen must drop. Development which requires immense investments from a wide range of stakeholders beyond MAN and 'Shared Hydrogen Campus' Bug explains:

"The tech is proven, and we know what to do. But the major challenge is on the infrastructure side. We require sufficient fueling stations, we need storage technology, we need standards. We are currently at a point which might be comparable to the late nineteenth century when they started to install fuel pumps. We really need to get into that process, and we can't do it on our own."

HYDROGEN FACTORY:
**GREEN MOBILITY STARTS
WITH GREEN PRODUCTION**

BMW Group is already using hydrogen and fuel cells to make mobility greener. Not only to power the electric motors of their cars but as a piece in their 'Green Plant'-project.

Every day, more than 1.000 vehicles roll off the production lines at BMW Leipzig Plant. It's not just one of the worlds most modern car production plants, but also one of the most sustainable.

"We have decarbonisation of the whole plant as a vision. It's a puzzle with a lot of pieces, and currently, we are the only plant with wind turbines, natural gas and high voltage battery storage space," says Dr Stefan Fenchel, Project Manager at BMW Group.

"Grünes Werk" - or The Green Plant - is the name of the project, which has made the plant CO2-neutral since 2018. The goal is to become carbon-free - which means not just offsetting the footprint but eliminate CO2-emissions all together.

BMW Group is pooling green technologies at the plant and pioneering specifically one area to reach this target.

"What we have developed since 2013 is the road of hydrogen. We were the first to set up an indoor hydrogen fuel station in our plant, and now we're setting up the fourth. Our indoor transportation based on hydrogen fuel is a success story that has been going on for several years. What people are talking about we've already done," Dr Fenchel says.

**A flexible fleet of
hydrogen industrial trucks**

With the surge of electric cars, hydrogen and fuel-cells have once again become a relevant technology for cars' future. BMW Group is working on the technology for their production cars alongside Toyota; however, the technology might not mature as fast as we might want for the mainstream-market.

Nevertheless, BMW started moving forward using hydrogen for their industrial trucks like tugger trains and forklifts at the Leipzig plant. This way, technology is creating value years before it's ready for cars. While BMW is one of the only companies already applying the technology at a commercial scale over battery-driven electric industrial trucks, the benefits are already showing.

"We could fuel 300 vehicles each shift at every filling station - and that is not possible with batteries. If battery-powered industrial trucks should be efficient, we would need 2-3 batteries per vehicle. With hydrogen, we just need one system for our whole fleet, which means less personal to handle the logistics," explains Thomas Stiede, the Logistics Planer at BMW plant Leipzig responsible for the hydrogen-project.

With hydrogen, it takes less than 3 minutes to refuel the fuel cell industrial trucks. And the hydrogen-pipes have been installed on the roof which makes it flexible and scalable to distribute the hydrogen across the plant. If the filling station has to be relocated, it can be done over a weekend.

“It’s a success story we can keep expanding. Of course, we had a learning curve, but now others are visiting us to copy this solution,” Thomas Stiede says.

Building the infrastructure

BMW’s ambition is to decrease the CO2-emissions in its production by 80 per cent before 2030. However, the production only accounts for 3 per cent of the energy consumption in the lifecycle of a car. Extracting and refining the materials and the actual usage of the car accounts for the vast majority. Even in the 3 per cent emitted during production, only 1/3 is at the plant, while the rest is caused by transportation.

In other words, the hydrogen-industrial trucks are only a tiny part of the solution. But it’s an important step toward hydrogen-cars, which holds vast potential. Even in the short term, there is a significant benefit: BMW leads the way toward a greener future by example.

“Bigger companies play an important role. Interlogistics has a huge effect on the outside world. We have gone that step and want to encourage others to follow our example because as the technology gets adopted at a bigger scale, it gets more impactful,” Dr. Fenchel says.

When BMW shows that hydrogen-industrial trucks are viable, it can spread to other plants in other industries. And scale is needed toward building hydrogen-pipelines across the Leipzig-region in 2024 before covering all of Germany in 2030.

“We don’t have enough wind energy or hydrogen suppliers in Germany at the moment, but in time we will. When we have access to hydrogen by pipeline, we can look at other use-cases. If we can install a hydrogen power plant in a few years, we can reach or even exceed the 80 per cent less CO2-emission in 2030. And if we can do it here it can be done anywhere,” Dr Fenchel says.

H2HAUL: The road to hydrogen trucks

- BMW Group is a partner in the Horizon 2020 H2Haul-project which will develop and demonstrate a total of 16 new heavy-duty hydrogen fuel cell trucks. In addition, new high-capacity hydrogen refuelling stations will be installed to provide reliable, low carbon hydrogen supplies to the trucks.
- The project will provide two heavy-duty hydrogen fuel cell trucks for BMW in the coming years to test in real-world commercial operations alongside a logistics service provider.
- H2Haul consortium consists of 15 partners from seven European countries. The consortium includes equipment manufacturers and analysis, dissemination and coordination partners including Bosch, Powercell, H2Energy and Iveco.
- The project runs from 2019 – 2024.

DEUTSCHE BAHN’S RACE TO ZERO FUEL CONSUMPTION

Deutsche Bahn has partnered with industry leaders and universities to explore alternative fuel sources and bid a final ‘farewell’ to diesel to become climate-neutral by 2050.

Germany is known for its ambitious climate goals, especially in the transportation sector. The country is currently in the process of shifting a majority of transportation to rail, not only for commuters but as an alternative to road, sea, and air cargo. However, a major roadblock is standing in the way. Only 39 per cent of the railway system is electric, leaving 13.000 kilometres of untapped potential. For its part, Deutsche Bahn is testing hybrid diesel, battery-powered locomotives, and hydrogen propulsion systems.

“Sustainability is part of the company’s DNA. Our ambition is to become the green pillar for sustainable transport in Germany by developing and optimising alternatives to fossil fuels. This means we have to keep on the forefront of research and innovation in carbon neutral transport solutions,” says Christian Höcker, the head of Deutsche Bahn’s Climate Neutral Programme:

In partnership with Siemens Mobility, the company is developing new vehicles and infrastructure, and testing the use of hydrogen for rail transport.

Höcker is quick to point out that there is still plenty of room for technological evolution when it comes to alternative forms of transportation, namely: “weight, reach, as well as recharging and refuelling infrastructure are some of the challenges that need to be addressed”.

While the company is eager to transform the railway industry. It is a serious challenge and it will require collaboration, knowledge exchange, and top notch research to do so.

“In order to come up with pioneering solutions for diesel alternatives, we’re collaborating with several German universities, including Karlsruhe Institute of Technology (KIT) and Technische Universität Dresden. For example, with KIT, we’re seeking opportunities to use hydrogen-burning engines, are testing alternative fuels like hydrotreated vegetable oils, and are measuring particle emissions,” says Höcker.

Deutsche Bahn’s test lab – TrainLab – is open to industry, research institutions, and university partners to run pilot projects. This is where Deutsche Bahn is shaping the future of transportation, safety guidelines, and alternative fuels to reduce their environmental footprint.

The Hydrogen Project:

A one-year trial run of the train is planned in the Tübingen area, thanks to the support of Baden-Württemberg’s Ministry of Transport. More recently, the Federal Ministry of Transport and Digital Infrastructure (BMVI) also announced funding support for the project.

Source: Deutsche Bahn press release

THE FUTURE OF MOBILITY IS BEING DRIVEN BY GERMAN ENGINEERING AND STRATEGIC PARTNERSHIPS

Top German universities have begun to pool their talent, and are inviting corporate partnerships to accelerate research and innovation on mobility.



The state of Baden-Württemberg is funding researchers at InnovationCampus Future Mobility to develop pioneering technology.
Photo: Markus Breig, KIT.

While autonomous vehicles have been making headlines since trials began in the 1950s, there is much more to the story than the technology itself. The question of whether they will be rolled out comes down to convenience, sustainability, and their ability to navigate 'liveable' cities. Overcrowding and traffic congestion in German city centres – like Stuttgart, Karlsruhe, and Munich – is already heavy during regular hours, let alone standard commuting times.

Yet, despite appearances, the future of mobility is bright, according to Dr. Max Hoßfeld, general manager of the InnovationCampus Future Mobility:

“Owning a car just to use it for an hour a day has always been a luxury and convenience but never been reasonable. Now with new mobility concepts, a rethinking of urban planning and upcoming generations that tend to be more interested in the environment than expressing their status by a car, we are going to see a major shift in mobility within the next years. These highly mobile generations will be more flexible and gravitate towards mobility as a service, based on their individual circumstances”.

• As an innovation hub, we
• foster an open culture and
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production

Dr.-Ing. Max Hoßfeld



Dr.-Ing. Max Hoßfeld, general manager of the InnovationCampus Future Mobility.

You need to look no further than southwest Germany to see how the government is responding to demographic and lifestyle changes. In fact, the state of Baden-Württemberg is funding researchers at InnovationCampus Future Mobility to develop pioneering technology. To create more sustainable forms of mobility, the campus is pooling expertise across the University of Stuttgart and Karlsruhe Institute of Technology.

A joint effort

Particularly in southern Germany, mobility and automotive production are vital to the history and economy. For many citizens, vehicles symbolise financial stability, prosperity, and are regarded as something to be proud of.

Bearing that in mind, Hoßfeld suggests that the ongoing transformation of mobility, related business models, and automotive production may be unsettling for them. Since it will require extensive changes to infrastructure, regulation, value creation, and daily life, “this transformation is a challenge that can only be navigated by engaging all stakeholders to inform the research agenda and strike a consensus between society, political entities, industry players, and scientists. We will see a major shift when and how we commute and what role the automotive industry plays”, Hoßfeld explains.

To that end, the campus welcomes external collaborations:

“As an innovation hub, we foster an open culture and are always looking for the best talent to address big transformational challenges in society, mobility, and production. We are open to connecting and working alongside

other excellent clusters, hubs, or projects from all over the world to integrate complementary external competencies into our portfolio”, says Hoßfeld.

Our institutes are very well connected in their respective fields, so we can integrate industry partners often already at an early stage of development

Dr.-Ing. Max Hoßfeld

While the partnership were only formalized this past year, the campus has already initiated a series of projects. And when it comes to knowledge transfer, the InnovationCampus Future Mobility uses levers from both universities and welcomes new collaborations.

As Hoßfeld explains:

“Our institutes are very well connected in their respective fields, so we can integrate industry partners often already at an early stage of development. In this way, we ensure that new knowledge from our fundamental research disseminates quickly via contractual research, applied studies, consulting, and also licenses. Alongside our advisory board, the campus management continuously evaluates our research projects for transfer possibilities and actively scouts for new applications and potential industry partners. We also strongly encourage and support our employees to found their own start-ups based on their research at the InnovationCampus.”

Pilot projects in emission-free drive systems and additive manufacturing

The first two pilot strategy fields deal with emission-free drive systems and additive manufacturing, meaning the use of 3D printers other than for high-quality and ready-for-use (lightweight) building components.

Source: www.icm-bw.de

SPACE VALLEY:
HOW BAVARIA’S RESEARCH AND INDUSTRY HUB ARE MAKING GREENER SKIES

The southern German region has a strong history in the aerospace industry. Using this stronghold across new partnerships is paving the way for ‘green aerospace’.

While Germany has long been known as Europe’s ‘car nation’, the country is becoming increasingly recognised for their efforts above ground. The region’s aviation history dates back decades and has penetrated military and civil airspace, not to mention industry and academia.

In the 100-kilometer radius surrounding Munich, you will find start-ups and established businesses alike who are working on everything from production technology to space applications.

In 2012, the Ludwig Bölkow Campus (LBC) opened its doors and has since drawn the region’s most prominent aerospace players to work on exciting cross-cutting projects. According to Professor Mirko Hornung, the Executive Director of Research and Technology at Bauhaus Luftfahrt:

“Combining the research coming out of Munich Aerospace—from the Technical University of Munich and Bundeswehr University Munich—with the German Aerospace Center and Bauhaus Luftfahrt was the nucleus. Since then, industrial partners like Airbus,



Thilo Pinar, the Managing Director of Ludwig Bölkow Campus GmbH.

IABG, and Siemens laid the foundation for the Ludwig Bölkow Campus, uniting industry and academia.”

Housed within the LBC, Bauhaus Luftfahrt is an independent, non-profit research institute that specialises in aviation. This innovative hub has attracted corporations, start-ups, and academics to engage in research and development in the aviation space. In describing their shared vision, Thilo Pinar, the Managing Director at LBC, points out:

“Our perspectives are to link regions through scientific training; foster knowledge exchange between science and industry; and become an international hub for trend-setting innovations, new approaches, and hands-on training in the fields of aerospace and security. Our overarching objective is to increase corporate competitiveness and benefit society by developing ground-breaking technology and engaging in top-level research to educate the next generation of scientists.”

From space exploration to green skies

In 2018, the Minister President of Bavaria, presented a new space strategy that injected 90 million euros into Munich's 'Space Valley'. However, instead of putting people on the moon, the goal was to develop innovative technologies for here on Earth.

This vision has taken form at LBC, where teams are focusing on achieving 'green aerospace' by reducing greenhouse emissions from planes and jets.

Dr. Hornung is quick to point out that the key technologies are interconnected: “On the engine side,

• *When it comes to reducing
• greenhouse gas emissions,
• the spotlight is on the move
• away from traditional energy
sources to alternative ones*

Professor Mirko Hornung

research is focused on improving the core technologies. Additive manufacturing and new materials are helping to reduce weight and enhance functionality. When it comes to reducing greenhouse gas emissions, the spotlight is on the move away from traditional energy sources to alternative ones”.

The research-intensive industry requires further interdisciplinary collaborations and massive testing facilities. To ensure knowledge is shared among the region's stakeholders – no matter whether the goal is incremental improvements or basic research into hydrogen-powered jets – one of the benefits in the Munich area is the cross synergies between space and aerospace. “All the expertise is here to answer any question”, Dr. Hornung points out.

Building upon a firm foundation

In Bavaria alone, there are 550 companies working within the aerospace industry that are employing nearly 60,000 people. As Pinar explains:

“Our partners on- and off-site cover the full range of technological readiness, from basic research (universities, research institutions), prototypes and demonstrations (small enterprises and start-ups) to full commercial applications (corporations)”.

While this mix presents its share of dilemmas, particularly the industry's time-to-market needs against research schedules, the opportunities far outweigh them from Pinar's vantage point:

“Professionals develop according to future needs. In particular, scientists take a target-oriented approach to future challenges and industry benefits from research to prove the feasibility and reduce risks in subsequent developments”.

GREEN CHANGE IS MORE THAN JUST A TECHNOLOGICAL CHALLENGE

A green transition depends on technological breakthroughs, but new technologies only succeed if they are broadly accepted.

Tech is important, but it's not everything. A green car is not the same as green mobility. This is according to Jessica Le-Bris. She represents the organisation 'Green City' which aims to make cities more sustainable by facilitating green change by implementing green spaces, new technologies, and mobility solutions for decades to come. They learned that deep integration and involvement across multiple stakeholders is crucial in the process of turning the green car into green mobility.

The organisation excels in bringing together various stakeholders around green projects—from industry and universities to municipalities and citizens to ensure that the parties share the same vision.

“When you have big ideas, you always need the consent and acceptance to get the support needed. Without the right context, the greatest idea can get sidelined. Our job is to make it a reality and accelerate those great ideas,” Le Bris says.

Stakeholders need translation

Southern Germany is experienced in bringing new solutions to the market in collaboration between industry and research. According to Jessica Le-Bris from 'Green City', lasting, impactful change also requires municipalities, politics and citizens.

“We have been working with municipalities to create strategies around green mobility, and we are always a big part of networking and bringing stakeholders together. The crucial part is that we plan it for the people, so we experience high involvement from different stakeholders. The hard part is to reach consensus—that everyone agrees about the goals and the road to get there,” Jessica Le-Bris explains.

When bringing new green projects into reality, engineers, politicians, and citizens speak different languages. People must understand and agree on the goal across disciplines, so innovation doesn't become a new stand-alone invention, but an integral part of the existing system. Through ongoing dialogue and capacity building, these seemingly disparate languages can be translated into a common one.

Engagement is crucial to partnerships

Many tech startups have great ideas and new solutions aimed at the green transition. But if they want to succeed, they need to understand how politicians work and how citizens behave. It's not enough to simply present the technology and expect it to be accepted as it is.

“They need to know politics and how municipalities work. And that's quite often where we come in. Your idea might be great, but how do you get it in there? They need to understand the need of the municipality. Maybe they need to bring in other partners and of course the customers. And all the stakeholders need to be involved in the development,” Le-Bris explains.

It's easy to present a vision and its potential benefits. But real impact comes with stakeholder involvement, and when learning and the development of solutions are collaborative endeavours.

ENTER THE GERMAN INNOVATION ECOSYSTEM

The southern German region has a strong history in the aerospace industry. Using this stronghold across new partnerships is paving the way for ‘green aerospace’

At Innovation Centre Denmark (ICDK), we offer Danish businesses, organisations, and higher education institutions access to the Southern German innovation ecosystem. Located in Munich, we provide deep insights and foster networks of entrepreneurial communities and research hubs. In collaboration with Innovation Centre colleagues in Tel Aviv, Sao Paulo, Silicon Valley, Boston, Bangalore, Seoul, and Shanghai, we follow global megatrends and perform tech scouting for our partners. Our global network is designed to connect to technological hot spots—enhancing best practices, sharing resources, and ultimately bringing value.

In 2019, the Innovation Centre in Munich closely examined the German industrial landscape in an effort to unlock the potential of the hidden champions of industry 4.0.

In 2020, we’ve continued to build demand-driven platforms, implement tech scouting activities, and develop long-term partnerships to create value for both German and Danish research and innovation stakeholders. We have since scaled this focus to tap into Southern Germany’s strong technological and industrial base and continue to assess the potential for green collaboration.

In 2021, we will expand our work through:

- partnerships among universities and industrial partners in Southern Germany and potential learnings for Denmark;

- green technology opportunities, including collaborations with Space Tech and energy storage companies;
- further developing our tech scouting concept and services for Danish tech companies and corporate and scientific partners in Southern Germany.

The current technological transformation and green transition requires innovative partnerships among industrial and scientific stakeholders. We encourage forward-thinking research institutions and tech companies that are eager to collaborate in new ways to reach out to us.

The Innovation Centre in Short

Advisory:

Our experts advise Danish companies by creating access to innovation partners, tech scouting, and the latest knowledge and investment opportunities.

Tech Scouting:

Our start-up flagship programme, GOB2B_Munich, provides a platform every September for Danish startups to showcase their solutions and technologies to German tech companies. We deliver bespoke tech scouting services to both Danish and German corporates seeking cutting-edge solutions. As part hereof, we bring dedicated problem owners in Danish companies together with technology solution providers in Germany.

Science:

With a focus on strengthening partnerships between universities and industry partners, including under Horizon Europe, we use workshops, and research and innovation camps to bring together researchers, companies, and other organisations in Denmark and Germany to discuss joint proposals and partnership opportunities.

Photo by: Adrian Trinka on Unsplash



Innovation Centre Denmark – Munich