Bluestreak

A NEWSLETTER BY QAPTIS
Q4 2024

STARTUP

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Welcome to the Bluestreak newsletter,
your quarterly dose of Qaptis news and insights.
Ready to decarbonize your business?
Let's talk carbon capture.

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A word to our community

Dear member,

2024 has been one of milestones for Qaptis. We were proud to finish 20th on the TOP100 Swiss Startups list—an incredible achievement that speaks to the hard work and dedication of our team. We also had the privilege of winning first place in the 2024 Global Green Innovation Challenge at COP29 in Baku, showcasing the global recognition of our mission. Besides achieving our technological and growth milestones, such recognitions brings us closer to making our CO_2 capture solutions a reality for industries worldwide.

Looking to 2025, we're not just continuing our efforts in the mobility sector—we're expanding into new areas. Stating project in stationary and industrial applications, opens up new opportunities to accelerate decarbonization in hard-to-abate sectors. This expansion is not only about growing our technology but also about staying true to our core mission: making a meaningful impact on the planet.

None of this would be possible without you. Your support has been crucial in helping us reach these achievements, and it will continue to fuel our growth and drive us forward.

Thank you for being such an important part of our journey. As we move into 2025, we're excited to have you by our side as we take the next steps toward a sustainable, low-carbon future.

Warmly,
Masoud Talebi Amiri

Latest news

Qaptis is among the renowned TOP 100 Swiss Startup Award 2024!

We did it! Qaptis has been named one of Switzerland's best startups, ranking as one of the Top 10 newcomers.

Ranking at #20 position, this incredible achievement recognizes our team's dedication to revolutionizing the field of carbon capture and shaping a cleaner future. A big thanks to everyone who voted for us and the award jury for trusting in our mission and our team.

We're very proud to be featured among other promising startups and to be part of a growing community of innovators. The #TOP100SSU definitively inspires us to reach new heights!

This award also opens doors to valuable partnerships and opportunities to grow our business.

🔗 Check out the full list of winners here.

Our CEO, Masoud Talebi Amiri, pitching at the award ceremony © Venturelab

🎥 Relive the excitement of our celebration! Click below to watch the replay of the award ceremony.

Our Mobile CO2 Capture system earns Solar Impulse Efficient Solution Label!

Having our plug-in CO_2 capture kit get this prestigious label is a true testament to our dedication to innovation and to creating a positive environmental impact without compromising economic viability. We're truly grateful to the Solar Impulse Foundation.

This label highlights the game-changing potential of Qaptis' technology in decarbonizing transportation and supply chains, paving the way for a cleaner future powered by waste heat.

🔗 More about the Qaptis solution: solarimpulse.com/solutions-explorer/mobile-co2-capture-system-joka

Curious about our technology?
Reach out at info@qaptis.com

Qaptis receives support from the Innosuisse Core Coaching

Major milestone achieved! Qaptis has completed the Innosuisse Initial Coaching phase and is now moving forward to the Core Coaching program. This will allow us to refine our go-to-market strategy, accelerate our growth and make a significant impact in the carbon capture field.

🔎 The Core Coaching is a selective program for startups run by Innosuisse, a Swiss government agency. It offers expert guidance in areas like intellectual property, financial planning, legal matters and fundraising.

An Overview of Swiss Cleantech Start-ups is out

Discover Qaptis on page 72 of this 2nd edition by CleantechAlps!

🔗 Get your free copy here.

« To achieve carbon neutrality by 2050, we will also need to remove significant amounts of CO2 from the atmosphere. Qaptis's mobile capture system will make it possible to eliminate up to 90% of CO2 emissions from heavy goods vehicles. »

— Théodore Caby, COO & Co-founder

© CleantechAlps

Tackling rising CO_2 levels in the atmosphere has become essential to fight climate change. Now imagine a chimney vacuum capturing greenhouse gas emissions directly at the source, preventing them from being released into the air. That's Qaptis!

We're really proud to contribute to the United Nations Sustainable Development Goals 9, 11, 12 & 13 by making cost-effective, retrofittable carbon capture a reality. But scaling this technology across hard-to-decarbonize sectors requires commitment and collective action.

The CleantechAlps report explains this well, highlighting the central role startups play in building a more sustainable economy, but also the importance of private-public partnerships.

Luckily, Switzerland is home to key cleantech players like Swiss Climate Foundation, Solar Impulse Foundation and swisscleantech. These organizations are instrumental in achieving a sustainable future, and we're happy to have them on board with us in achieving our shared mission!

Qaptis takes home Top Prize at the COP29 Global Green Innovation Challenge!

Last November, all eyes were on COP29 Azerbaijan, where world leaders paved the way for a more sustainable and resilient future for our planet during the United Nations's flagship Climate Conference. The clock is ticking on climate change, but innovation is offering solutions like ours.

Advocating for a carbon-neutral society, Qaptis is incredibly proud to have been part of the Global Green Innovation Challenge and to have won the 1st prize!

Congratulations to our CEO, Masoud Talebi Amiri for his winning pitch! He has undoubtedly returned from Baku inspired and more committed than ever to climate action.

Our CEO, Masoud Talebi Amiri, receives 1st prize © Qaptis

We join Moove Lab's accelerator program

We're delighted to announce that Qaptis has joined Moove Lab's Batch 13! Six months of intensive coaching with mobility experts await us. Our goal? To accelerate the deployment of our CO_2 capture solution for heavy-duty vehicles.

We're eager to dive into the vibrant ecosystem of STATION F, the world's largest startup campus, and collaborate with France's leading mobility accelerator and its partners to tackle the challenges of tomorrow's transportation landscape. Follow us on LinkedIn to discover the behind-the-scenes of this adventure.

🔎 Powered by MOBILIANS x Via ID - Mobivia, the program benefits from an impressive network of partners that will support the startups: BMW Group, EDF, EIT Urban Mobility, Roole, OPTEVEN, BCA Expertise, Bessé, bee2link group, ANFA, OPCO Mobilités, NextMove.

Moove Lab's batch #13 with our COO, Théodore Caby, in Paris © Moove Lab

Qaptis is in the Semifinals of the 2025 Prix Strategis

What a fantastic end of the fall season! We're buzzing with excitement to have reached this new milestone. Huge thanks to the jury and organizers of the Prix Strategis for this incredible opportunity.

We're committed to develop groundbreaking solutions that address the critical challenge of climate change. This recognition fuels our passion to push the boundaries of innovation even further and create a more sustainable future for all.

Stay tuned for further updates on our progress in the competition!

🔗 Press release: 8 Semi-Finalists Selected for the 2025 Prix Strategis

Qaptis breaks ground on waste Heat-to-Power system

We're thrilled to announce that Qaptis has successfully built its first waste heat-to-power system, moving one step closer to commissioning! This innovative project marks a major step forward in our efforts to develop sustainable and efficient carbon capture technology.

Big thanks to our partner, Enogia, for their expertise in making this happen.

But how does it work, may you ask?

This subsystem uses the waste heat from the exhaust gases of vehicles and converts it into electrical energy to power our CO_2 capture kit. So no external energy source is needed to generate power!

Why this side project matters

This waste heat valorization testifies Qaptis' commitment to generate clean energy and thus create CO_2 capture solutions with the lowest possible carbon penalty, creating a truly virtuous cycle.

Moving forward, we'll be focusing on a smaller version of such system for our prototype CO_2 capture kit. Such energy management systems will be part of our minimum viable product (MVP), further enhancing the sustainability and cost-effectiveness of our carbon capture solutions.

Qaptis is proud of the entire team for their hard work in reaching this milestone. A special shoutout to our Lead Engineering, Mitulkumar Suthar, for leading the way.

The future is green, and we're just getting started!

From research to the road: Qaptis supports a KTH master's project commissioned by Scania

This semester, we have been supporting a student from the KTH Royal Institute of Technology, a prestigious Swedish university in Stockholm, in their master's project. This project, initiated by Scania, a global leader in heavy truck manufacturing, focused on a critical topic: mobile carbon capture (MCC) using solid sorbents for trucks.

By supervising research projects on MCC, Scania once again demonstrates its commitment to the energy transition in the road transport sector. This initiative is a strong signal from the market: decarbonization has become a top priority for industry players!

We would like to express our sincere thanks to Scania for allowing us to support this MSc thesis project. We also congratulate the student on the quality of their work. Their project is a valuable contribution to research on carbon capture solutions for heavy-duty vehicles.

Expert opinion

State-of-the-Art of Carbon Capture, Utilization and Storage

Shivom Sharma & François Maréchal — Postdoctoral Researcher & Professor @Industrial Process and Energy Systems Engineering (IPESE), EPFL, and Co-Founders @Qaptis

Global CO_2 emissions associated with energy reached 36.3 Gt in 2021 [1]. The Intergovernmental Panel on Climate Change (IPCC) predicts that by 2100, atmospheric CO_2 concentrations will reach 730–1020 parts per million, raising the planet's average temperature by 2.4-5.6 °C [2]. By 2050, the world must achieve net-zero in order to keep global warming to 1.5 °C over pre-industrial levels.

A key technology option for lowering CO_2 emissions and reaching net-zero emission targets is carbon capture, utilization, and storage, or CCUS. Due to severe climate change and growing policy support, CCUS has accelerated significantly in recent years. In 2023, announced carbon capture and storage capacities for 2030 increased by 35% and 70%, respectively, over 700 projects were in various phases of development, and approximately 45 CCUS plants were operational. The current global carbon capture capacity has reached more than 50 Mtpa [3], but the current deployment is insufficient to realize net-zero emission target by 2050.

Carbon Capture

In 2020, power production sector had 36.6% contribution to global CO_2 emissions, followed by industrial combustion (21.8%), transportation (20.1%), other sectors (12.1%) and buildings (9.4%) [4]. Figure 1 presents various steps in CCUS procedure. It can be challenging to capture CO_2 emitted from some sources, such as municipal and agricultural waste as well as moving sources like ships, aircrafts, and cars with internal combustion engines. In these situations, CO_2 can be extracted from the air using direct air capture.

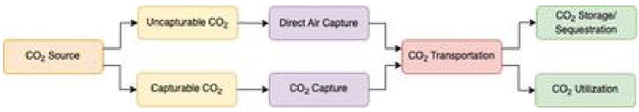

Figure 1: Overview of various steps in CCUS

For capturable CO_2, mainly from power plants, industries, buildings, there are three categories of carbon capture technologies: pre-, post- and oxy-combustion. In the industrial sector, pre-combustion carbon capture is a popular procedure that involves removing CO_2 from fuel prior to its combustion. For example, pre-combustion carbon capture is applied to produce syngas from coal, natural gas or biomass that is used to synthesize chemicals or fuels. In post-combustion carbon capture, CO_2 is separated from the flue gas after fuel is burned with air to generate heat or power.

Table 1 lists several technological options for CO_2 separation following air combustion along with their technology readiness levels (TRL). Lastly, oxy-combustion of fuel is employed in oxygen rich atmosphere, and subsequently, combustion products are cooled-down to condense the water and separate CO_2.

Table 1: Post-combustion CO2 separation options with technology readiness levels (TRL); TRL1-3: research, TRL4-6: development, TRL7-9: deployment [4]

TRL	Technological Options
1 Concept	Electrochemically mediated adsorption
2 Formulation	Encapsulated solvents, ionic liquids
3 Proof of Concept	Encapsulated solvents, ionic liquids, electric swing adsorption
4 Lab prototype	Water lean solvents, amino acid-based solvents, electric swing adsorption, polymeric membrane-liquid solvent hybrid, room temperature ionic liquid membranes
5 Lab scale plant	Water lean solvents, phase change solvents, amino acid-based solvents, temperature swing adsorption, chemical looping
6 Pilot plant	Sterically hindered amines, water lean solvents, phase change solvents, chilled ammonia, temperature swing adsorption, temperature pressure swing adsorption, vacuum pressure swing adsorption, enzyme catalyzed adsorption, chemical looping, calcium looping, membrane physical adsorbent hybrid, polymeric membrane cryogenic separation hybrid
7 Demonstration	Sterically hindered amines, water lean solvents, chilled ammonia, temperature swing adsorption, calcium looping, polymeric membranes
8 Refinement	Sterically hindered amines
9 Commercial	Traditional amine solvents, physical solvents (Selexol, Rectisol), Benefield process (K2CO3), sterically hindered amines, pressure swing adsorption, vacuum swing adsorption

Post-combustion CO_2 can be separated using a variety of techniques, including chemical and physical absorption, adsorption, chemical/calcium looping, membrane system, cryogenic separation and biological capture. For approximately 90% of the CO_2 removal from flue gas, typical energy consumptions by chemical absorption (MEA), physical absorption (Rectisol), adsorption (zeolite 13X), calcium looping, membrane (polymeric) and cryogenic separation are respectively 3.8, 1.88, 1.17, 2.25, 1.28 and 1.8 GJ/t-CO_2 [5, 6]. Hybrid CO_2 capture techniques (such as membrane-cryogenic and membrane-adsorption) are also being developed to take advantage of the synergies between different technologies.

Chemical Absorption

One established method for capturing carbon is chemical absorption. Common solvents in chemical absorption processes include primary (MEA, mono-ethanolamine), secondary (DEA, diethanolamine), and tertiary amines (MDEA, N-methyl diethanolamine). With a 4.09 mol-CO_2/kg-solvent, 90% CO_2 recovery, and 99% CO_2 purity, MEA is the most effective amine for carbon capture [5]. High energy consumption, equipment corrosion, solvent evaporation, and solvent degradation are characteristics of MEA-based processes. As shown in Table 1, a number of solvents for chemical absorption, including sterically hindered amines, water lean solvents, phase change solvents, amino acid solvents, encapsulated solvents and ionic liquids, have attained various TRL levels. Ionic liquids have shown high absorption capacity, and requires only 1.4 GJ/t-CO_2 energy [5]. Further, compared to the MEA process, the chilled ammonia process operates at low temperature, and has lower energy consumption.

Physical Absorption

When flue gas contains more than 15 vol.% CO_2, physical absorption is more energy efficient and has a lower operating temperature than chemical absorption [4]. Selexol (polyethylene glycol dimethyl ethers), Rectisol (cold methanol), Purisol (N-methyl-pyrrolidone) and Fluor (propylene carbonate) are the most popular physical absorption processes. Pre-combustion carbon capture, in methanol and ammonia synthesis, frequently uses physical absorption. The absorption-desorption cycles can be operated by both temperature swing and pressure swing.

Adsorption

Adsorbent-based system can be used for pre-combustion, post-combustion, oxy-combustion and direct air carbon capture. Both temperature swing and pressure swing can be applied in adsorption-desorption cycles. The adsorption-based system for CO_2 capture has used a variety of sorbents, such as metal oxides, alkali metal-based compounds, amine-based sorbents (chemical sorbents), activated carbon, zeolites, and Metal Organic Frameworks (MOFs) (physical sorbents). While CO_2 molecules are poorly bound by a physical sorbent, they are firmly bound by a chemical sorbent.

Amine-based sorbents offer a high CO_2 adsorption capacity and selectivity, strong water tolerance, and minimal corrosion, but they are expansive [7]. Metal oxides-based sorbents can capture CO_2 from flue gas at medium (MgO) to high temperatures (CaO), while alkali metal-based sorbents ($Na2CO_3$ or $K2CO_3$) can capture CO_2 at low temperatures. It is worth-mentioning that CO_2 can be captured from hot flue gas (such as cement plants) using a process known as calcium looping [6], which uses CaO. Finally, the Benfield process ($K2CO_3$) has attained the technological maturity [8].

Physical sorbents are suitable for carbon capture at low temperatures. Although activated carbon has a moderate CO_2 adsorption capacity and selectivity, it can be used for CO_2 capture because of its high thermal stability, water tolerance, and affordability. Zeolite 13X has a high adsorption capacity and is inexpensive, but it has poor CO_2 selectivity. MOFs have the potential to perform well in CO_2 capture. Adsorption capacity of MIL-101(Cr) is 14.4 kg-CO_2/kg-material, at 1 bar. The synthesis of MOFs is often extensive, and their performance is sensitive to water presence [5].

The desorption mechanism determines the various operating modes of the adsorption process. While pressure swing adsorption has high electricity consumption, temperature swing adsorption usually has long desorption time. Hence, several alternate processes have been devised to improve the energy efficiency and the desorption step. Compared to pressure swing adsorption, vacuum swing adsorption uses less energy and produces a higher-purity product, but it recovers less CO_2. Temperature pressure swing and vacuum pressure swing adsorptions are being investigated in an effort to improve product recovery and quality, and energy usage.

Further, novel electric swing adsorption has shorter desorption time at the expense of lower product purity and recovery [9]. Finally, electrochemically mediated adsorption is a promising technology that uses redox-active sorbents to capture CO_2 [10], whereas enzyme catalyzed adsorption uses enzymes on the solid surface to capture and transform ambient CO_2 into compounds with added value [4].

Membrane System

For CO_2 separation, a variety of membrane types have been developed, including inorganic, polymeric, mixed matrix, facilitated transport, and gas-liquid membrane contactors [4, 5, 12]. To obtain high purity and recovery of CO_2 product, a multi-stage process with recycling possibilities must be designed and optimized [11].

Inorganic membranes, which are composed of carbons, oxides, zeolites, or MOFs, often have limited permeability, high fabrication costs, and good mechanical and thermal stabilities. Since polymeric membranes (polyarylates, polycarbonates, polyimides, and polysulfones) have excellent permeability, CO_2/N_2 selectivity, and are less expensive, they are used in commercial carbon capture plants. Additionally, polymeric membranes exhibit high mechanical stability and low thermal stability that necessitates flue gas cooling prior to CO_2 separation. Polymers of intrinsic microporosity (PIM) membranes are promising new types of polymeric membranes with excellent CO_2 separation performance.

Mixed matrix membranes offer enhanced properties and stabilities due to their composite structure made of polymers and inorganic fillers. Although mixed matrix membranes function better than inorganic and polymeric membranes, their fabrication is relatively expansive. Facilitated transport membranes incorporate functional groups on polymer matrix to achieve superior separation and mechanical qualities. The fabrication of facilitated transport membranes presents challenges. The most advanced next-generation membranes are ion-exchange, liquid supported, and fixed carrier membranes. For CO_2 capture from flue gas employing fixed carrier membranes, an estimated energy consumption of 1.02 GJ/t-CO_2 has been reported [13].

Gas-liquid membrane contactors use hydrophobic polymeric membrane between flue gas and absorption liquid (such as amines or ionic liquid). The liquid absorbs the CO_2 as it diffuses across the membrane. This approach uses less energy since it does not require a pressure differential between the feed and permeate.

Cryogenic Separation

This technique creates highly pure liquid CO_2 at low temperature and high pressure by compressing and cooling flue gas in multiple stages. This is a costly and energy-intensive technique. Thus, waste cold energy such as LNG regasification can be reused for cryogenic separation of CO_2. For the separation of CO_2 at low temperatures, a number of cryogenic techniques have been developed, including packed bed, distillation, anti-sublimation, and controlled freeze zone [14]. The product CO_2 via cryogenic separation is usually free from any impurities.

Biological Capture

As a biogeochemical cycle, the carbon cycle connects the hydrosphere, geosphere, atmosphere, and biosphere. Biological CO_2 capture is the conversion of ambient CO_2 into proteins, carbohydrates, lipids, and other compounds by living organisms, specifically microalgae, cyanobacteria, and plants [15]. Bio-photolysis with cyanobacteria or microalgae, ocean fertilization, and forestation can all lower the CO_2 concentration in the atmosphere. Further, microalgae can be grown using flue gas, and obtained biomass can be used for fuel production.

CO2 Transportation

Connecting the CO_2 sources to the storage locations and utilisation facilities is a crucial component of CCUS. CO_2 can be transported in liquid form by trucks, rail, or ships, or in supercritical phase through pipelines. Water must be eliminated during compression or liquefaction, prior to CO_2 transportation, in order to prevent pipeline or tank corrosion. While CO_2 transportation by trucks and rail is appropriate for smaller quantities and shorter distances, CO_2 transportation by pipelines and ships has been commercialized [4, 5].

CO2 Storage/Sequestration

Once CO_2 is compressed above 74 bars, it is trapped in deep oceans or geological formations (such as coal seams, saline formations, depleted oil and gas reserves, and basalt and ultramafic rocks) for a long time [4, 5, 12]. In 2020, the cost of storing CO_2 in U.S. onshore geological reserves was 1.72 $/t-$CO_2$. The estimated CO_2 storage capacity of depleted oil and gas reservoirs (TRL7) ranges from 675 to 900 Gt.

Subterranean porous rock formations, known as saline formations (TRL9), are thought to have a 1000-10,000 Gt CO_2 storage capacity. Additionally, research and CO_2 are underway for long-term CO2 storage in basalt and ultramafic rocks (carbon mineralization, TRL2-6), coal seams (TRL3) and ocean storage (TRL2). Additionally, building materials can be produced by mineralization and carbon capture. It is interesting to note that the projected potential of carbon mineralization to store CO_2 is enormous, roughly 60 million Gt.

CO2 Utilization

In 2019, global CO_2 utilization was 230 Mt, with the fertilizer industry and enhanced oil recovery accounted for 57% and 34%, respectively [5]. There are two categories of CO_2 use: direct utilisation and conversion to products. Applications for direct CO_2 use include yield boosting (e.g., microalgae cultivation), solvent (e.g., enhanced oil recovery, enhanced coal bed methane recovery), heat transfer fluid (supercritical power cycle, refrigeration cycle) and other applications (e.g., food, beverage, wielding, medical use). Numerous fuels (such as methane, methanol, and Fischer-Tropsch fuels), chemicals (such as olefins, aromatics, and polymers), and construction materials can be made from the captured CO_2.

The use of CO_2 to synthesize various products is shown in Table 2, along with technology readiness levels.

Table 2: CO2 utilization/conversion options with technology readiness levels (TRL); TRL1-3: research, TRL4-6: development, TRL7-9: deployment [4]

TRL	Technological Options
1 Concept	Malates
2 Formulation	HCHO, alkanes, aromatics, olefins, carbamates, isocyanates
3 Proof of Concept	Dimethyl ether, acetic acid, acrylic acid, CO_2-based enzymatic and microbial products
4 Lab prototype	Ethylene glycol, oxalic acid, lactones, $MgCO_3$
5 Lab scale plant	CO_2-based Fischer-Tropsch and bio-fuels
6 Pilot plant	Syngas, ethanol, formic acid
7 Demonstration	CO_2-based polymers, $CaCO_3$, Na_2CO_3
8 Refinement	Methane, dimethyl carbonate, cyclic carbonates, $NaHCO_3$, concrete curing
9 Commercial	Methanol, urea, salicylic acid, polyols, polyurethane, polycarbonates

As discussed above, there are a number of options for carbon capture, storage, and utilization. Selection and implementation of a carbon capture technology depend on several crucial factors, such as energy consumption, product recovery and purity, material/solvent stability, source type (stationary or mobile), CO_2 stream flow rate, and possible synergies with the CO_2-emitting industry.

While some carbon capture techniques (e.g., pressure swing adsorption, membrane separation) operate on electricity, others (e.g., MEA-based absorption and temperature swing adsorption) use heat. A significant quantity of waste heat is released into the atmosphere by industry, gas and coal power plants, and gasoline/diesel vehicles. Heat-driven carbon capture techniques may be more effective when waste heat is available. In literature, various carbon capture processes have been well designed, integrated and optimized. The performance of a carbon capture technology mainly constrained by the separation properties, stability and cost of the solvent, material or membrane utilized. Therefore, to accomplish energy-efficient and economical carbon capture, future research should concentrate more on the development of better solvents, materials, and membranes that can be employed in the design of carbon capture systems.

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Startup life

The Qaptis team gathers for its annual celebration event

What better way to end the summer season than by celebrating our #20 spot in the Top 100 Swiss Startup Award with a party?

As our co-founder & COO said in his speech, the past year at Qaptis has been filled with success, hard work, and, let's be honest, challenges to overcome. None of this would have been possible without the dedication and passion of our team, advisors, partners, investors, family and friends. Thank you all for being part of our journey! See you soon 🥂

The Qaptis team:
Masoud Talebi Amiri
Théodore Caby
Marie Tournant
Edward Green
Mitulkumar Suthar
Stéphanie Ferreira
Kenneth Geibel
Francesco Jannuzzi
Emanuele Piccoli
François Maréchal
Shivom Sharma
Emanuele Giusti
Eric Aboussouan
Marc Van Gent

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Japanese decarbonization delegation visits Energypolis innovation park

A high-level Japanese delegation visited Campus Energypolis, in mid-September as part of their Swiss Innovation Parks tour. Their exploration focused on innovation and sustainable technology.

During this visit, our co-founder, Théodore Caby, had the opportunity to pitch our technology to the delegation, alongside other cleantech startups like DePoly, WattAnyWhere and Urbio.

We're grateful to the Swiss Business Hub Japan for inviting us to connect with this inspiring group! Collaborating with international innovators is essential for advancing global decarbonization efforts and strengthening ties between Switzerland and Japan 🇨🇭🤝🇯🇵

The delegation group and the Swiss startups © Swiss Business Hub Japan

Qaptis welcomes Francesco Jannuzzi to its team

With over 20 years of experience in international business, Francesco brings a wealth of knowledge in sales, business development and supply chain management. His proven track record in securing deals and driving operational excellence will be invaluable to our team. We're delighted to have him support us!

« I am thrilled to provide leadership and advice to Qaptis. We all know that many industry customers are facing a tough challenge on reducing carbon emissions. Many of them are turning to point-source CO_2 capture, and in this space, Qaptis brings a solution that is both simple and pragmatic. The goal is to make thousands of heavy vehicles and other machines run as normal, but emitting 90% less CO_2 than they do today, all with an easy retrofit. »
— Francesco

Exlusive dive into Emanuele Giusti's PhD work on modeling CO_2 capture

But first, meet Emanuele!

Coming from Florence, Italy, Emanuele Giusti has joined our team as an Industrial Engineer through a doctoral exchange program between the Università degli Studi di Firenze and EPFL 🇮🇹🇨🇭

We're thrilled to have had Emanuele's expertise on board from past March to August! He worked on projects related to CO_2 capture in heavy-duty vehicles, as well as semi-stationary and stationary applications.

Emanuele G. has a bachelor's degree in Mechanical Engineering and a master's degree in Energy Engineering.

His fields of application are related to energy systems, specifically design, simulation and analysis of Organic Rankine Cycles (ORCs) and renewable energies-based systems, and emissions treatment solutions evaluation, with experience in modeling but also in conducting experiments.

Focus on his research work in Emanuele's words:

"Study of carbon dioxide capture, utilization and sequestration (CCUS) systems for thermal machines"

General context

Due to adverse climate changes, nowadays, capturing the CO_2 that can be released into the atmosphere from every type of source is no longer avoidable. Among the source types which can release CO_2 into the atmosphere there are electricity and heat generation, industry and transportation. Sponsored by a generator set company, my doctoral work mainly focuses on studying solutions for the capture and utilization of CO_2 from this type of thermal machines. In Qaptis, I have explored the mobile CO_2 capture technology for heavy duty vehicles and I have collaborated with the Lead Scientist, Emanuele Piccoli, to develop the technology further.

I have immediately considered Qaptis's project as essential, believing it to be much more realistic than other solutions to the CO_2 problem in the transportation field.

The research work in more detail

I have worked on experimental tests and in the development of a model to simulate the CO_2 capture system.

For the simulation part, it has been difficult to obtain the chosen adsorbent data needed to set-up the model, particularly regarding multi-component adsorption isotherms correlation models coefficients. An extensive and exhaustive literature review has been performed in order to search and obtain the required adsorbent data.

Finding in the literature studies about exactly the same composition of the gas stream considered in the model has not been possible. For this reason, it has been chosen to make use of the Ideal Adsorption Solution Theory (IAST).

Another difficulty has been about adsorption isotherms correlation models. Finding in the literature studies providing coefficients related to the same correlation model for all the compounds has not been possible. In fact, the modeling software requires that every compound has to be described by the same isotherm correlation model. So, a re-fitting of the isotherm adsorption data discovered in the literature has been made via MATLAB and its Curve Fitting tool.

Results and next steps in the project

Thanks to the work done, it has been possible to set up a model for the simulation of the Temperature Swing Adsorption (TSA) process.

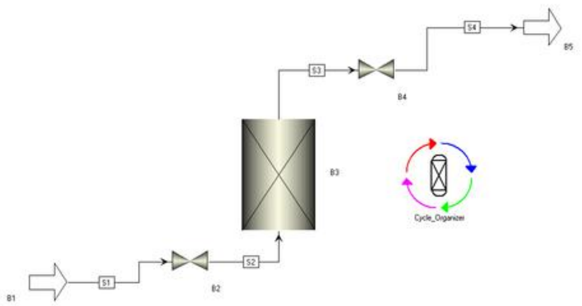

Figure 1 – Modeling the TSA process © Emanuele Giusti

The optimization of this model and the extension of the modeling to the entire capture system will be the subject of the future work, which can be used both in the area of CO_2 capture applied to gensets and in that related to heavy duty vehicles.

Also, an experimental evaluation of adsorption multi-component isotherm data of the working gas stream has to be performed in order to obtain a more accurate model.

References

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Latest events we attended:

📍 Kellerhals Carrard’s Party in Lausanne, September 19

📍 Forum EPFL in Lausanne, October 8

📍 GITEX GLOBAL in Dubai, October 13-16

📍 Industrial Future Summit in Stockholm, October 15

📍 Showcase 2030 Sustainable Solutions Exhibition in Lausanne, October 29

📍 Executives International Startups & Mentors in Lausanne, November 13

📍 ECTA Annual Meeting in Düsseldorf, November 14

📍 COP29 in Baku, November 16

📍 Slush in Helsinki, November 20-21

Those events are an opportunity to showcase what we’ve been working and meet some inspiring people. Come and chat with us!

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› Insight: Qaptis invente un filtre à CO2 à la sortie des pots d’échappement

› TOP 100 Swiss Startups: Cleantech Innovations: How Swiss startups are shaping a greener future

› CleantechAlps: 2nd edition of the Overview of Cleantech Start-ups

› GO2050 (see Qaptis on p.30): L’actu des solutions durables (Novembre 2024, n°4)

› Leonard: The three biggest trends from Slush 2024

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— The Qaptis team