

PerfectPartners

A new kind of education: How HySET leverages the power of academic–industry collaboration

In this article, we hear how the power of academic–industry collaboration and the Hydrogen Systems and Enabling Technologies (HySET) consortium are setting the standard for hydrogen education in Europe. *Shell TechXplorer Digest* executive editor Evren Unsal (EU) chatted with HySET programme lead Professor Massimo Santarelli (MS) and programme coordinator Mariapia Martino (MM) at the Department of Energy (DENERG) at Politecnico di Torino (PoliTO) to learn more.

EU: First, tell our readers a bit about yourselves.

MS: I'm a professor in Advanced Energy Systems (electrochemistry, hydrogen processes and technologies, carbon dioxide (CO₂) conversion and thermochemical processes) in the Department of Energy at PoliTO. I also have affiliations with KTH in Stockholm, UPC Barcelona and UIC Chicago. I work across the domains of electrochemical and thermocatalytic processes, and I'm the HySET programme lead.

MM: I'm in charge of educational activities and international training programmes at DENERG in POLITO, and also the HySET programme coordinator. Some say I'm the administrative driving force behind the HySET consortium. I'm also heavily invested in the well-being of our students and our relationship with Shell.

EU: For our international readers, can you tell us a bit about PoliTO and its Department of Energy "Galileo Ferraris"?

MM: PoliTO is one of Europe's top technical universities for teaching and research, training engineers, architects, designers and urban planners. We have almost 40,000 students and more than 1,000 faculty members. Founded in the mid-19th century as the Scuola di Applicazione per gli Ingegneri (School for Engineers), it was Italy's first engineering school. In 1906, it became Il Regio Politecnico di Torino.

MS: The DENERG "Galileo Ferraris" is focused on researching and developing existing and new energy technologies and promoting the sustainable use of energy resources. Currently, we are working on about 20 European projects with academic and industry partners, including three Erasmus Mundus (EM) Joint Masters programmes.

EU: One of those programmes is HySET, the first EM Joint Masters degree dedicated to the hydrogen supply chain. Can you explain a bit about the programme?

MM: The programme was originated by the HySET consortium, a collaboration led by PoliTO, which includes five academic partners and five industry partners from across Europe, including Shell (see box, **The HySET Consortium**). The programme will run for four years and welcomes two cohorts, each studying for a two-year master's degree.



Massimo Santarelli

Mariapia Martino

Evren Unsal

Perfect Partners examines the emerging collaborative ecosystem for research and development, involving Shell and other organisations working together to address the challenges of the energy transition.

We welcomed our first cohort of about 20 students in September 2023, and our second started in 2024. In their first year, students are split into groups to study here in Turin or in Milan. We bring them together in three seasonal workshops offering specialist training in business and entrepreneurship.

EU: This is a unique programme that brings together academic and industry partners. What makes this master's degree different?

MS: The structure of the consortium and the style of education is unique in Europe. We have five large European companies collaborating directly with the programme and its students. Universities are great at science, but working with industry partners helps guide our research to bridge the gap between the underlying science and real-world challenges and technologies.

Having companies like Shell, Repsol, Snam, SINTEF and Safetec on board is a sign that the programme and our students have the potential to help solve the real challenges that these companies and their sectors face. Moreover, seminars by industry partners are invaluable, as they place the science and theory in the context of emerging technologies, commercial considerations and the policy environment.

MM: The programme also focuses on applied learning. Students don't just learn in the classroom: they collaborate in small groups to develop potential solutions to real challenges posed by consortium industry partners.

EU: Shell is a member of the HySET consortium. What has Shell brought to the consortium?

MS: It's been great having Shell on board. Its people are global experts in fuel, energy, chemicals and processing technologies. Shell doesn't just work with anyone, so to have Shell as part of the consortium gives us the credibility and visibility needed to attract the best young minds and the funding needed.

But Shell isn't just a big name – it's really committed to the course and the students. People such as yourself, Evren, and the experts and tutors from Shell have helped elevate the programme by contributing to day-to-day activities, supervising theses and hosting students at Shell's Energy Transition Campus Amsterdam (ETCA). I have to say that Shell was a very popular choice when the students were deciding who to work with on their theses.

EU: You mentioned that Shell has been a popular choice for students – five of them were hosted as interns at ETCA. How important was this experience for them?

MS: The feedback from the students has been extremely positive. I think being immersed in the ETCA ecosystem is such a rare opportunity for young students and really can be a life-changing experience.

I know the students entered a very friendly and collaborative environment and worked with people from all over the world, which is great because science and technology is a very international field. They also worked on some very complex



Mariapia and Massimo at Eindhoven, February 2025.



Celebrating our pioneers in hydrogen education – the first HySET graduation ceremony.

challenges that have inspired them to think about what to do next – see box, [The HySET Consortium](#), for some examples. Some are considering doing a PhD, like the Shell experts they worked with.

EU: It's great to hear that feedback. From Shell's perspective, this was something new for us. We often host Dutch interns at ETCA, but bringing several students from one EM programme from across Europe was something we hadn't done before.

With HySET, we've been more involved in helping our selected students move to and settle in Amsterdam. Building strong personal connections between students and supervisors has helped us build a really collaborative environment.

On a practical point, the process has given extra structure to some of our larger projects by dividing them into six-month mini projects. Our interns were very proactive, working on complementary topics that we might not have the time to focus on. Overall, for us, the technical and mentorship aspects of hosting the interns and learning about the education systems in other countries has been hugely valuable.

MM: One of the big positives is that all the students that interned at Shell presented their masters' theses at the 14th International Conference on Renewable Energy Research and Applications (ICRERA 2025) in Vienna. This was an excellent opportunity to showcase their work and talents and gain experience communicating science and technology.

EU: *The first cohort of HySET students graduated this October. What were your emotions seeing your students collecting their certificates?*

MM: It was a very emotional day seeing all the students in their caps and gowns, sharing the moment with their families and classmates. It's the result of a lot of hard work for them and us. We spent several years preparing the proposal for the programme, and four years later I see the results. It was a wonderful moment.

MS: Yes, it was a wonderful day for all. During the ceremony, I saw the exceptional quality of work the students had produced. I don't work with them every day, so seeing all their research and the diversity of topics at the end was very pleasing. Also, the ceremony was organised brilliantly by Mariapia. We have beautiful buildings at PoliTO, so it was a perfect location.

MM: Also, we invited the current cohort, who will be graduating next year, to the ceremony. They were very impressed with the quality of the theses and said it inspired them when thinking about their own research.

MS: I totally agree. To see what previous students have achieved has been really important for our current cohort. The feedback from them has been very positive.

EU: *Beyond HySET, PoliTO has recently become an academic member of Shell's ETCA. How important is this to your research?*

MS: The collaboration with Shell's ETCA is very important to us. Hydrogen is just one part of a

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The HySET Consortium

Coordinator: Politecnico di Torino

Academic partners: Politecnico di Milano (Italy), Eindhoven University of Technology (Netherlands), Norwegian University of Science and Technology (Norway) and Universitat Politècnica de Catalunya (Spain).

European industry partners: Shell (Netherlands), Snam (Italy), Repsol (Spain), SINTEF (Norway) and Safetec (Norway)

Shell HySET intern projects published in *Shell TechXplorer Digest*

- **Eleonora Parente:** The subsurface storage of hydrogen: Pore-scale modelling
- **Giuseppe Calabrese:** A simulation-based evaluation of a [direct air capture](#) system with coupled electrochemical and thermochemical processes
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- **Adisa Jarubenjaluk:** Advancing [overpressure quantification methodology](#) for hydrogen venting

larger energy transition challenge, so it's important for us to broaden our domain of research into areas such as artificial intelligence, new chemical processes and alternative bio- and synthetic fuels for transport, aviation and shipping. Partnering with ETCA helps us to do this.

Interestingly, I have professors here at PoliTO saying: "Wow, this collaboration with Shell is really interesting. We have the chance to know so much more." And this is true. I expect professors from other domains will soon be discussing opportunities to collaborate with Shell. So, in the future, we see our partnership with Shell being much bigger than HySET.

EU: In reverse, Shell colleague Steffen Berg and I had the pleasure of spending a month with you at PoliTO as part of a knowledge-exchange programme. Arnoud Higler will also be visiting PoliTO in January 2026 as part of the same activity. Tell us a bit about this.

MM: Every three years, Italy's National Minister of Educational Research awards a grant to the best 100 departments in Italy, so there's a lot of competition between universities and

departments. We were fortunate to win an award, which inspired us to host the exchange with you and Steffen.

I think that the experience was very valuable for both parties because we had the opportunity ➤➤➤



ICRERA conference dinner – Vienna, Austria, 29 October 2025.

to learn more about the research activities of a large company like Shell. And you and Steffen could understand the research we're doing at PoliTO.

EU: I agree. Our time at PoliTO was very positive. The chance to have informal, ad hoc chats face-to-face really helped the exchange of ideas. We would often chat with faculty and students, sometimes all sat around on the floor. It was very informal and very relaxed.

We were also able to meet non-HySET faculty members and explore different opportunities for research and knowledge exchange. HySET has been a great platform to expand our collaboration with PoliTO. Without the consortium, maybe this exchange wouldn't have happened. I'm optimistic that new projects outside of HySET will develop.

EU: An example of this broader collaboration is a joint grant proposal that you've recently submitted with the German Aerospace Centre (DLR), Shell and other partners to the Clean Energy Transition Partnership programme. Can you tell us a bit about it?

MS: Yes, we want to explore the untapped potential of solar thermochemical cycles as a pathway for renewable hydrogen and fuel production, promising efficiencies significantly superior to current standard technologies. DLR is the leading partner of the grant proposal, and Shell is proposed to lead the work package on techno-economic analysis, life-cycle assessments and social acceptance to evaluate commercial viability and environmental impact. The industrial perspective will allow barriers and opportunities to be identified. DLR has now (November 2025) joined ETCA – so this proposal is a joint effort by three ETCA members!

EU: Shell is also co-sponsoring a PhD student at PoliTO. How did this come about?

MS: We are interested in researching chemicals that can perform electrochemical processes enhanced by sunlight – a sort of hybrid between electrochemical and thermochemical. I made a proposal to Shell,

who liked the idea, so we agreed to co-finance the project, which began in March this year.

A PhD is a good way to start a new line of research. And the great thing about Shell is that it's also very interested in the research process; it's not just looking for quick answers. So, I've recently proposed a second PhD project to Shell, focused on solar chemicals. We have two great HySET students who interned at ETCA who are considering a PhD. So, they could be excellent candidates.

EU: Finally, how do you reflect on the first edition of the HySET consortium? What does the future of HySET look like?

MM: I think HySET has shown us a new way to educate students. The mix of classroom teaching and applied learning guided by an experienced industry partner like Shell is a winning combination. Students tell me every day how valuable it is working with companies and industries and how it gives them a real sense of what their future could be.

MS: For me, HySET has shown how a committed partnership between academia and large companies can lead to great innovation and should be a model for modern education, particularly in research and technology. It's an environment where talented students can flourish and develop the real-life skills that we need for the energy transition.

Going forward, we plan to apply for further European Union funding to extend the HySET consortium for another five years. But this time, we want to expand beyond just hydrogen and look at hydrogen-derivative chemicals. Also, my ambition is to expand the consortium outside of Europe. We've already had discussions with universities in Brazil, Japan and the USA. We'd also like to collaborate with one or two universities in Africa. This is our global vision. ■

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