



FCHgo!



EN SCRIPT

FCHgo! INTERVIEW

Massimo Santarelli – Politecnico di Torino (Department of Energy)



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(Barbara Grazzini, InEuropa srl): Good morning everyone. Here we go again with the interviews within FCHgo, a project for schools based on hydrogen use. Today, our guest is Professor Massimo Santarelli from the Politecnico di Torino Department of Energy.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Good morning everyone. That's right.

(Barbara Grazzini, InEuropa srl): Professor Santarelli, I would like to express heartfelt thanks to you for coming here today, to talk about a project which sees the Politecnico participation as a partner. This is a Horizon project, as FCHgo, and it is supported by the same axis as Horizon in the hydrogen field. Could you tell us what the project is about? We are curious and willing to create synergistic relationships with FCHgo.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): We can boast several projects on this specific subject and this is one of them. Now, I am the coordinator of two projects concerning hydrogen. The one we are going to talk about today sees the Politecnico as the only Italian partner. At a certain point we decided with colleagues working in this field on a European and global level, that it was time to meet each. The final purpose was to develop a European curriculum able to bring together all major universities actively interested in the hydrogen and fuel cells topic. These academic institutions can praise the finest skills on a scientific and technological level: these competences and their untiring efforts will create a common curriculum that will be used in many different universities. The project is called TeachHy, an acronym for "teaching hydrogen" and the main focus is to connect the most influential universities in Europe regarding this specific sector. Naturally, professors and researchers have thorough expertise as well as being well-known professionals. We do believe that giving life to this academic curriculum by connecting the most proficient men will result in a high level of education in Europe. We are a consortium, ready to join forces and generate a common curriculum thanks to the best researchers in the field.

(Barbara Grazzini, InEuropa srl): It is certainly an ambitious project. I think it is interesting to see the education approach to hydrogen. FCHgo addresses schools and with this project there is a continuity: in fact, you offer university courses based on training students in this field and masters, like this one, that increases your level of expertise. You told me that this is not only for recent graduates, but also for professionals, right?

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Yes, the project is focused on the creation of a curriculum at master level. The concept of master, however, should not be interpreted in the "Italian way". It is not a master of science, as to say a specialist degree in Italy, two years after the primary three years. Academically, there is a three-year specialist curriculum in master of science on hydrogen and fuel cells. The project is built on theoretical activities, but also on lab experiments. We all have labs that we can use for this purpose. By the way, I am setting up a high temperature solid oxide fuel cell test stand which I am trying to adapt to the smartworking mode. This is a real experiment, not a model and it can be done from every corner of the world. If there is a student who is living in Birmingham or Copenhagen he can easily do a real experiment like he is at my place, selling objects and taking note of data. In addition to real labs, there is also the opportunity to try remote testing. Its structure is that of a Master, but there are also many insights because this is still an intermediate level, so the topics can be very specialized. We offer the opportunity to do various in-

depth studies and, from a scientific point of view, there are the most disparate subjects. As for in-depth studies, we have already developed them and they are more addressed to the PhD level, a doctoral level. This is the main focus of the Master, but we are also taking into consideration to give lectures also at bachelor level, as to say the first three years of university. The idea for lifelong learning is to provide materials and lessons also for professionals who are already working in the field. Nowadays, hydrogen is becoming more and more important in Europe and far beyond. Outside Europe they put a lot of emphasis on energy transition. The sector has immediately understood the value of this gas and I am constantly on the phone, receiving calls every single day. A revolution is acting out, there is a shower of contracts not only on a basic research level, but also regarding industrial research. This is the reason why I think a lot of interest will be raised in industries as well, so much that they will ask for educational material on the subject.

(Barbara Grazzini, InEuropa srl): Absolutely. This is a good message for high school students who will have to make important decisions in terms of university or work. This is a green sector that will certainly lead to stimulating job opportunities.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): It seems to be like this. The sector has speeded up incredibly fast. It is a field that has its ups and downs -I have been working in it for 25 years, that's why I know this - but the current acceleration seems to be completely different. However, the European Union has been very exposed in economical terms, so much that the funding for the next ten years is enormous. Hydrogen is a small molecule, but it has a huge potential in contemporary society for its various applications which make it important in terms of primary sources and final uses, a territory where hydrogen works very well. There are many prospects for work in the hydrogen sector for engineers, physicists, chemists, those who like to work in the scientific field. There will be plenty of job opportunities .

(Barbara Grazzini, InEuropa srl): I would like to ask you a question we haven't agreed before. From the interviews, the path we are taking the children along, the use for cars... We have seen that there will be the first project of an hydrogen boiler in a school in Modena...

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Yes, I also know about it because I replied to the competition announcement.

(Barbara Grazzini, InEuropa srl): We had the chance to interview Engineer Vita from Modena, the person who presented us this project. Our FCHgo project supposes the participation of students in an international competition announcement we have created as part of the project. Students can come up with ideas concerning hydrogen and its applications in the most disparate fields. My question is necessary in order to give the children more concrete information on how to use hydrogen beyond the boiler and cars standard application. So, what kind of uses can you think of regarding this gas?

(Massimo Santarelli, Politecnico di Torino, Department of Energy): There are several employs. Hydrogen is an element that acts as a storage element of renewable sources present in large quantities, with great power and long durations. For example, if I have to keep a community of 500 people alive on an island, using the renewable sources existing on the island only solar panels and wind power, without importing oil, diesel and coal, the direct combination between the renewable sources and the final result will not always be guaranteed. In fact, at night solar panels do not work and we have to find something intermediate. There are batteries, of course, but we have to consider that the battery sector is not able to serve a community of 500 people, except in the scenario of the use of huge quantities at very expensive costs. Let's talk about a city or a region, not only a community of 500 people. Hydrogen stands as an accumulation element of renewable sources in a clean way. Once the

renewable energy is stored under chemical form, in the form of hydrogen, the moment it is reused, it produces water. Hydrogen is a clean substance, if its origin is a renewable source. This gas is strongly employed in the energy storage area – or energy storing. There is a whole world regarding the application of hydrogen in industry. In the industrial sector, this means decarbonising industrial processes. One example for all: steel production, an international business. If you start with basic minerals you need to reduce them using coal because of their oxid form. The same process should be put into practice using hydrogen – in this case, it becomes sustainable. In the steel industry there is a transition in order to decarbonise the process. In fact, the production of many chemicals is based, as atoms, on elements such as coal, hydrogen, oxygen, nitrogen, sulphur - of course, coal and hydrogen are always present. If hydrogen is produced from renewable sources, it would make the production of chemicals - synthetic polymers, synthetic gasoline, waxes and oils – but, if they are produced using green hydrogen, they become synthetic products produced from renewable sources: so, they are no longer extracted from oil. I could give billions of examples but, at the moment, we restrict ourselves to put all these cases in the macro category of decarbonisation of industrial processes.

(Barbara Grazzini, InEuropa srl): Absolutely. Thank you, this helped us have a new insight into the interviews and information we had already received from others.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Yes, because there is this idea of hydrogen as a fuel for cars.

(Barbara Grazzini, InEuropa srl): Correct.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): This is an interesting aspect, the use of hydrogen in the automotive market -which is so important - but we also need to focus on what could be the employ of this gas in the industrial, residential and commercial sectors. There's a huge array of possibilities.

(Barbara Grazzini, InEuropa srl): Thank you. Back to the TeachHy project, I was wondering if you have something to show us, maybe some slides or maybe you want to tell us if you will make this sort of presentation or you have already prepared them. However, the project is going on and it will have an extension. You have already prepared some training packages, which will be in the form of MOOC online, correct?

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Yes, they will be online. Accessibility, anyway, is a delicate point to discuss. These didactic contents will not be free – like YouTube – because they are certified. Being provided by universities, the consortium members or others that will become consortium members will have free access to this kind of content. It is just like a certified course of study which issues a title. The course will be in remote teaching mode, with videos, slides, information content, but it is part of a university course of study, it provides a certificate, so only few people can participate. You have to enrol to the university and pass the exams.

(Barbara Grazzini, InEuropa srl): Absolutely. I don't know if you want to show.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Let me show you quickly. Can you see it?

(Barbara Grazzini, InEuropa srl): Yes, I can.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): This is a laboratory, I was telling you before that I'm remotely using a test stand. This one on the right is a test stand for high temperature fuel cells, those based on solid oxides. They are electrochemical cells, they can either

generate electricity or hydrogen at high efficiency (more than 60%), or they can work backwards, as to say if I have electricity I can generate hydrogen at winged efficiency. These cells are structured machines. This is my laboratory, these are two postdocs who work with me. They are dressed up like this because they are using solid oxide. Due to the nickel oxide presence, you have to protect the respiratory tract, but only on a lab level, if you use it outside that particular context, there is no need. This is fundamental for an experiment. This stand will be available for remote testing, so that a person who is in Hong Kong can do the experiment directly on my stand by running the stand itself, opening the flow controls, making the flow go and making the machine generate current, and the current, the voltage, the impedance are actually measured. It is a real experiment even if it is done aloof. This is something I can show you and that is part of the curriculum. Another thing, just to give you an idea.

(Barbara Grazzini, InEuropa srl): It is interesting because you are telling us something completely new.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): The remote stand, especially after Covid, has been spreading around.

(Barbara Grazzini, InEuropa srl): We will overcome all the pandemics that can occur.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): We had already started doing this before, but with the pandemic it has become even more functional. These are the mandatory modules required, just to give a general idea of the course. These activities can be done in a superficial way, but also at a very high scientific level. This is intermediate and, as you can see, there are fundamental elements of Thermodynamics, Chemistry and Electrochemistry. This is what KIT (Karlsruhe) deals with, the bases to understand what happens in these processes. Then, Birmingham is in charge of the introduction to fuel cells in general terms. The EPFL in Grenoble works with all the methods of experiment characterization, like characterizing fuel cells or hydrogen production processes. I cannot emphasise enough that these are all top level European universities. We have been mainly involved in the fuel cell modelling processes - from the machine modelling to the fine molecular modelling at the basic Dynamics level. Then there is the "Hydrogen production, storage, handling" part, then hydrogen generation, storage and management. There is a specific activity in labs which sees the Politecnico responsible for it. The University of Ulster in Northern Ireland is responsible for "Hydrogen safety". Professors are all experts in the field, they are the European key reference in terms of hydrogen safety. This is the basic module and then there are optional in-depth studies: life cycle analysis of hydrogen, in-depth studies on low temperature and high temperature fuel cells and also market regulation issues.

(Barbara Grazzini, InEuropa srl): It may be interesting, as you said before, to promote this kind of operation and the availability of Master's degrees because it could become accessible for them as an in-depth study. Now, I am also thinking about the synergies we are creating with companies, with networks of companies that deal with hydrogen or that are approaching it.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Companies either enroll their employees to the Master's degree or, if they are large companies, they can ask us for a package for their employees. For example, if ENI demanded this type of service, we would study an ad hoc path for them based on the material we have already created.

(Barbara Grazzini, InEuropa srl): Absolutely. Maybe primary schools students will see these notions as complicated, but looking through these interviews - I also turn to teachers- it is interesting to see how these issues are discussed. It is obvious that there is more and more professionalism as you



grow up, your knowledge deepens and you discover specific, certified paths in a particular sector. I do believe that it is important to emphasise this message – that should reach everyone, also families - because a person can get there. This is the future.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): This is one of the elements of the energy transition we are setting up at international and above all European levels. While Europe is, perhaps, the standard bearer, Europe, Japan, California are the vanguards.

(Barbara Grazzini, InEuropa srl): We are happy that Italy is always in the middle because it is the spokesperson of the project.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Yes, a bit of Italian style, though.

(Barbara Grazzini, InEuropa srl): No, we don't say it.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): We are not like Germany, but Italy has a fairly good winning network of European projects on the hydrogen subject. Italians are professional in this specific field.

(Barbara Grazzini, InEuropa srl): This is important.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): On a central level, we could have done better but talking about universities, research tanks and industries, there is a high-skilled environment.

(Barbara Grazzini, InEuropa srl): That's right. Well, we have talked about a lot of topics and we have received a great deal of information, but I think it is important to give a signal also from other universities such as the Politecnico di Torino. I can only thank you, Professor Santarelli, for the examples you have given us, which will be certainly useful for young people who will try to find new ideas concerning the hydrogen applications. Thank you again, maybe we will keep in touch, also because we want to know how the project will end, as well as creating correlations that can give as much information as possible on the same topic at all levels.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Definitely.

(Barbara Grazzini, InEuropa srl): Thanks again.

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Thank you!

(Barbara Grazzini, InEuropa srl): Good morning!

(Massimo Santarelli, Politecnico di Torino, Department of Energy): Goodbye.

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