21. Mai 2017 hat sich jedoch einmal mehr gezeigt, dass grosse Unsicherheiten über die Eignung der verschiedenen Formen der Energiegewinnung bestehen und bisweilen nicht hinreichend faktenbasiert argumentiert wird. Eine neue Studie zu Kosten und Lebenszyklusemissionen [1] hilft, die Debatte zu versachlichen, indem sie für den Zeitraum bis 2050 u.a. Kosten- und Treibhausgassenkungspotenziale (z.B. für Photovoltaik) aufzeigt. Die Gesamtenergiebilanz verschiedener Technologien war jedoch bis jetzt nicht klar dargelegt.

Kernaussagen der Studie

– Die Studie belegt eindrücklich die positive Gesamtenergiebilanz der Wasserkraft. Doch auch Photovoltaik und vor allem Windkraft zeigen positive Werte. Beeindruckend ist aber, wie deutlich die Wasserkraft andere Formen der Stromerzeugung beim Erntefaktor überflügelt.
– Die Effizienz von Photovoltaik und Windkraft ist in den vergangenen Jahren deutlich gestiegen und weitere Verbesserungen sind künftig zu erwarten. Der Ausstieg aus der Kernenergie hat das Potenzial, die Gesamtenergiebilanz und damit die Nachhaltigkeit der Stromproduktion in der Schweiz zu verbessern und nicht umgekehrt, wie bisweilen postuliert.
– Der Umbau des Schweizer Energieversorgungsystems führt dazu, dass der Anteil stochastischer – also schwankender – Stromproduktion aus Photovoltaik und Windkraft weiter steigt. Die Speichertechnologie wird also künftig eine immer wichtigere Rolle als Regelenergie einnehmen.
– Bei Stromspeicher-Technologien sind Wasserspeicherkraftwerke gegenüber Power-to-Gas-to-Power-Verfahren und Batterien klar im Vorteil. Trotz der aktuell schwierigen ökonomischen Situation der Wasserkraft sollte die Schweiz also aus Sicht der Gesamtenergiebilanz auch künftig an ihr als wichtigste Säule der Stromversorgung festhalten.
– Obwohl umstritten, waren staatliche Förderprogramme wie die kostendeckende Einspeisevergütung (KEV) wichtige Impulsgeber für Innovationen im Energiesektor. Sie schaffen Anreize für die Installation entsprechender Kapazitäten, was die technologische Entwicklung entlang der Lernkurve beschleunigt.
– Andere nicht-stochastische erneuerbare Energieformen, wie die Geothermie, können künftig ebenso eine wichtige Rolle einnehmen. Deshalb sollte die Politik prüfen, ob auch für diese Technologien ein Fördermechanismus anzustreben ist.
– Schliesslich stützen die Erkenntnisse der Studie den von Bundesrat und Parlament mit der Energiestrategie 2050 eingeschlagenen Weg, der einen starken Zubau neuer erneuerbaren Energien in der Schweiz vorsieht, auch aus Sicht der Gesamtenergiebilanz.

Beatrice Huber und Adrian Sulzer (SATW)

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1 Bauer, C., et al (2017), Potentials, costs and environmental assessment of electricity generation technologies, Bundesamt für Energie BFE, Ittigen, 01.11.2017

Great success at the International Physicists' Tournament

Evgenii Glushkov, EPFL, Laboratory of Nanoscale Biology

It was a very intense Easter break in the life of six 3rd year physics students from EPFL. And a very successful one! They were representing Switzerland in the final of the International Physicists' Tournament (IPT 2018, *http://2018.iptnet.info/*) and competing against teams from fifteen other countries. And they did it so well, that Switzerland won the tournament for the first time in 5 years!

Here are the names of our heroes: Alberto Rolandi (captain), Laurent Michaud, Noémie Planat, Virginie Solans, Mathieu Suter and Marion von Allmen. They also had two very experienced helpers from last year's team – Quentin Dubey, who helped the students dive much deeper into the physics of the problems than they could have ever imagined, and Arthur Parmentier, who taught the team to present their solutions in a clear, structured and appealing way. Those two helpers made my role as a team leader quite easy – just bring the team to Moscow and let them win the tournament.

Now, a couple of words about the IPT itself, which celebrated this year its 10th edition. It originated from a physics tournament held in Ukraine in the 2000s, then moved to Russia in 2011 and became truly international a couple of years later. IPT has been extensively growing in the last several years and by now is the world's biggest competition in physics for university students. The tournament plays an important role in letting undergraduate students get hands-on research experience early in their scientific career. And in contrast to the standard lab exercises, which they have in their curriculum, it provides the students with the unique freedom to choose their own way of tackling an open physics problem – from lit-

erature study to the data analysis – much like any research is carried out in the scientific world. And most problems don't require complex scientific equipment to be solved, so the students can work on them even at home!

The range of problems they can choose from is quite wide as well. Each August the teams all around the world receive a list of 17 physics problems, carefully selected and assembled specifically for the tournament by the International Organizing Committee of the IPT. The topics of the problems can vary from hydrodynamics and optics to black hole formation. Many of the problems require building a simple experimental setup and optimizing it to fulfil a specific task. For example, one problem from the IPT 2017 asked the students to make a device that can most quickly and efficiently dilute a spoon of honey in a teacup. And some teams went so far as building a real piece of engineering art with servos to turn the spoon and lasers to check how well the honey was mixed with tea!

Several months after the list of problems is published, the teams from different universities within each country meet for the National Selection, the winner of which will be representing the country in the International Final. The IPT final is traditionally held each year in April and each edition is hosted by a different university from one of the participating countries. As I mentioned earlier, the international final usually lasts for one week, during which the teams have several qualifying physics fights and the grand finale with the top three teams.

Those of you who have never heard of a physics fight might be a little disappointed, as there is no fighting at all! Instead, the whole concept is focused on discussing physics at the deepest level possible! Though, I must confess, sometimes the discussion might become quite hot, but our well-educated students can still hold their temper. And, naturally, the professional tone of the discussion and the respectful behaviour during the fight are influencing the grades the teams get from the jurors, so it all creates a very friendly and constructive environment for the students.

It is quite hard to tell where the structure of the physics fights originally came from, but it was definitely inspired by the International Young Physicists' Tournament – a widely known competition for the high-school students. There are three roles in a physics fight: a Reporter, who during 10 minutes presents the solution to one of the IPT problems, an Opponent, who analyses the presented solution, shows its strengths and weaknesses and suggests how it might be improved, and a Reviewer, who gives an overview of both Reporter's and Opponent's performances and moderates the discussion between them. At some point the teams can also join the discussion and at the end the players are given marks by a respectful panel of juries followed by valuable comments. This constitutes one round of a physics fight. Logically, the whole fight consists of three rounds, which gives each of the three teams in the fight an opportunity to try on the role of Reporters, Opponents and Reviewers.

Of course during the IPT the students not only enjoy the physics fights, but also have a unique opportunity to interact with each other in an informal setting, learn various traditions of physics education in different countries and explore the culture of the hosting country! So the very fact of being part of the IPT final is a great reward to the students for all the months of hard work spent on preparation for the tournament! And this is how the participants themselves, who just cannot forget this wonderful experience they had at the IPT, pass the spirit of the tournament from year to year! This happened to me as well. After playing in the IPT 2015 I couldn't grow apart from the tournament and, while continuing my studies and becoming a PhD student, I also adopted the role of a team leader and the IPT representative in Switzerland.

If you got excited as you were reading this – it's just the right moment to get involved! Just send an e-mail to *switzerland@iptnet.info* or directly to *evgenii.glushkov@epfl.ch* and express your interest! If you are a professor at one of the Swiss universities – you can tell your students about the IPT and see if they can form a team. Likewise, if you are a student – talk to your friends and see if they like the idea of the tournament! This is how most of the IPT teams were started and we do hope to see more of them appearing in Switzerland! And of course we are happy to share our experience on preparing for the tournament, playing in physics fights, getting credits, etc., so you won't have to start from scratch!

Also, for the National Selection, which in Switzerland will happen during a weekend in early December, 2018, you just need to prepare solutions for a couple of problems from the list, which won't be that time-consuming. So my message is – why don't you come to EPFL next December to try to beat the winners of the IPT 2018? And, who knows, maybe in a year you'll be holding the trophy of the IPT 2019?!

Last, but not least, I would like to thank the EPFL Vice Presidency for Education for sponsoring the team's plane tickets, the Swiss Physical Society for covering the registration fee and promoting the IPT in Switzerland, itself supported by the platform MAP of the Academy SCNAT, and EPFL Physics Section for fully supporting the team throughout months of preparation for the tournament! Special thanks also go to Ms. Martine Truan, administrative assistant of LBEN, for making the travel arrangements for the whole team.

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