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EXECUTIVE SUMMARY

This deliverable encompasses the final collection of EU-13 success stories as part of the "Meet the EU-13" digital campaign. The objective of this initiative is to support *Task 1.4 Widening. Recommendations for mobilisation of National Public Research resources in EU-13* and help promote the research resources of EU-13 countries.

Moreover, the goal of SUPEERA through this campaign is to support EU-13 stakeholders to further network and engage with the EERA community, the SET Plan, and the Clean Energy Transition, by providing a platform for EU-13 actors and increasing the visibility of EU-13 relevant institutes and research centres.

The organisations portrayed in the "Meet the EU-13" were:

- Research Centre for Sustainable Energy - FOSS (Cyprus)
- Tallin University of Technology - TalTech (Estonia)
- Centrum výzkumu Řež - CVŘ (Czech Republic)
- Institute of Power Engineering – IEn (Poland)
- Budapest University of Technology and Economics – BME (Hungary)
- RTU Institute of Power Engineering at the Riga Technical University – RTU (Latvia)
- The Lithuanian Energy Institute – LEI (Lithuania)
- Malta's College of Arts, Science and Technology – MCAST (Malta)
- University of Ljubljana – UL (Slovenia)
- Universitatea Politehnica Timișoara – UPT (Romania)
- Slovak Technology University in Bratislava – STUBA (Slovakia)
- Energy Institute Hrvoje Požar – EIHP (Croatia)
- Centre for Energy Efficiency – EnEffect (Bulgaria)

I INTRODUCTION

On January 1st, 2020, the SUPEERA project[1]- ***SUP****port to the coordination of national research and innovation programmes in areas of activities of the* ***E****uropean* ***E****nergy* ***R****esearch* ***A****lliance* – was launched.

The project aims at reaching four high-level objectives:

1) Facilitate the coordination of the research community in support to the execution of the SET Plan towards the Clean Energy Transition;
2) Accelerating innovation and uptake by industry;
3) Provide recommendations on R&I priorities and policy frameworks through the development and analysis of energy and macroeconomic indicators;
4) Support and promote the connection of the SET Plan and the Clean Energy Transition with all stakeholders.

To achieve this last objective, the SUPEERA project foresees spreading excellence and broadening participation in the SET Plan across Europe by, among other goals, encouraging a broader engagement of the so-called EU-13 countries. These countries are mainly eastern countries (Poland, Slovakia, Czech Republic, Hungary, Romania and Bulgaria), the Baltic States (Estonia, Latvia, Lithuania), and south and south-eastern countries (Malta, Slovenia, Croatia and Cyprus).

To support the above, SUPEERA launched a digital campaign (Meet the EU-13) encompassing up to 13 stories – one for each country – presenting the scientific landscape, major players, networks, infrastructure, expertise, and engagement in the SET Plan of the selected countries.

Initially, the country stories were envisaged to be aligned with and cross-fertilised by the physical workshops organised in EU-13 countries by including audio-visual material from these workshops, such as conference recordings, footage of the R&D facilities, interviews and testimonials from different actors. However, the organisation of these workshops was delayed due to the restrictions deriving from the measures addressing the Covid-19 pandemic. Such a situation redressed the work in a way that could be developed using the online resources at hand. Even after in-person activities were resumed, as the approach proved effective, the work continued to be carried out mainly through online sources and channels.

1.1 Objectives

Currently, the above-mentioned EU-13 countries have relatively low participation in the realisation of the SET Plan through the execution of its Implementation Plans. The objective of SUPEERA'S digital campaign "Meet the EU-13" is to provide a platform to promote the research resources of EERA and non-EERA stakeholders in EU-13 countries and to increase their visibility.

[1] SUPEERA Website: https://www.supeera.eu

The subject of the stories is relevant infrastructures, research and development initiatives, and projects that are part of the efforts to achieve the targets of EU Climate and Energy strategies. By showcasing the achievements of these stakeholders, the final purpose is to encourage the involved actors to make the most of their potential and increase their collaboration in EU-wide initiatives as well as their participation in the SET- Plan and the Clean Energy Transition.

II METHODOLOGY

The SUPEERA project initially identified national research organisations from targeted EU-13 countries with low-level activity in the SET Plan Implementation Plans at present but with a potential to be engaged in their execution in the near future. In order to raise awareness on the SET Plan and the EERA community, a series of workshops (at least 8) in different EU-13 countries were planned. From these workshops, 13 stories dedicated to stakeholders from EU-13 countries and cross-fertilised with the outputs of the meetings were foreseen. The stories would have featured videos showcasing both the SUPEERA workshops and the infrastructures and research initiatives of the selected EU-13 stakeholders.

However, this was not possible initially due to the restrictive measures in response to the Covid-19 pandemic. Therefore, the SUPEERA project set out an alternative plan to identify and develop the first stories under these circumstances. The new approach entailed liaising with EERA members based on EU-13 countries and conducting online interviews.

The selected members were:

- Research Centre for Sustainable Energy - FOSS (Cyprus)
- Tallin University of Technology - TalTech (Estonia)
- Centrum výzkumu Řež - CVŘ (Czech Republic)
- Institute of Power Engineering – IEn (Poland)
- University of Ljubljana – UL (Slovenia)
- The Lithuanian Energy Institute – LEI (Lithuania)

The six organisations were contacted to explore their interest in participating in the digital campaign. Once this was validated, a first online meeting was held to identify the topic to be featured. The topic was decided in agreement between the SUPEERA consortium in charge of this task and the EERA members involved, in close connection with the SET Plan activities.

The following steps consisted of the exchange of useful documents for the drafting of the written part of the story and the development of relevant interview questions. Finally, the online interviews were carried out with representatives of the EERA members and edited into shorter video capsules highlighting aspects of the work not only of the institution but also of the country that go beyond the content emphasised in the texts.

Figure 1 compiles the outlined steps and schedule structure to present the initiative to the institutions and research centres involved.

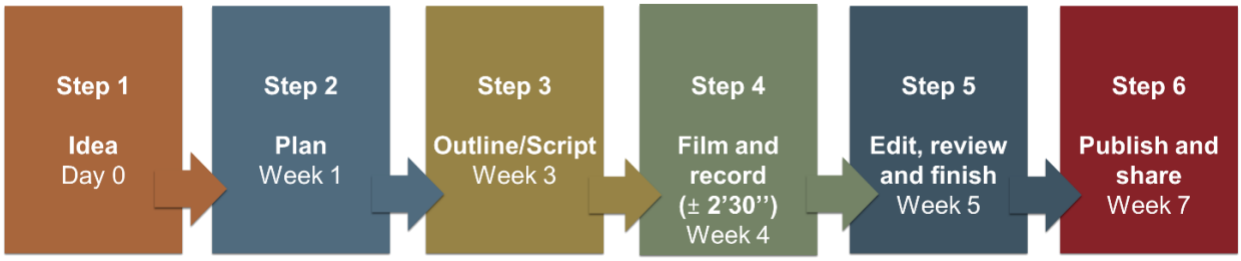

Figure 1: Planned steps and schedule for the development of the countries' stories

With the remaining seven countries, the approach taken was slightly adapted. In this opportunity, the task's leading team selected the topics that better reflected the country's priorities as defined on their NCEPs and identified the organisations that had carried out initiatives in these fields. The stories were developed using storytelling techniques to make the content more engaging.

The following stories to be developed were:

- Budapest University of Technology and Economics – BME (Hungary)
- RTU Institute of Power Engineering at the Riga Technical University – RTU (Latvia)
- Malta's College of Arts, Science and Technology – MCAST (Malta)
- Universitatea Politehnica Timișoara – UPT (Romania)
- Energy Institute Hrvoje Požar – EIHP (Croatia)
- Centre for Energy Efficiency – EnEffect (Bulgaria)

The final output of this activity is thirteen web pages inside the SUPEERA website, one per country, that include text, images, and, in some cases, video interviews and helpful contact details.

III DISSEMINATION

All the stories are part of the digital campaign "Meet the EU-13" and are published on a dedicated section within the SUPEERA website, Meet the EU-13 menu item. Each country with its corresponding story has an exclusive webpage.

All the stories are being shared through the EERA communication channels that enjoy higher visibility (website, newsletter, social media). In addition, synergies with the communication channels of SUPEERA's linked third parties and the EU-13 actors that are protagonists of the stories will be sought.

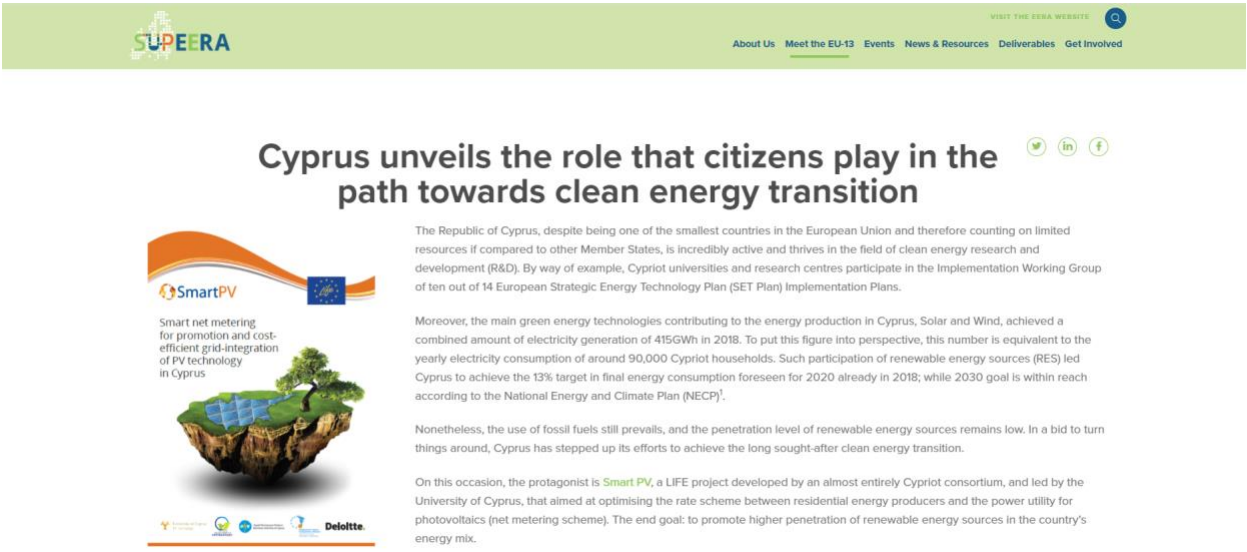

Figure 2: Example of the country story of Cyprus published on the SUPEERA website.

IV THE COUNTRIES' STORIES

4.1 Cyprus unveils the role that citizens play in the path towards clean energy transition

Written content

The Republic of Cyprus, despite being one of the smallest countries in the European Union and therefore counting on limited resources if compared to other Member States, is incredibly active and thrives in the field of clean energy research and development (R&D). By way of example, Cypriot universities and research centres participate in the Temporary Working Group of ten out of 14 European Strategic Energy Technology Plan (SET Plan) Implementation Plans.

Moreover, the main green energy technologies contributing to the energy production in Cyprus, Solar and Wind, achieved a combined amount of electricity generation of 415GWh in 2018. To put this figure into perspective, this number is equivalent to the yearly electricity consumption of around 90,000 Cypriot households. Such participation of renewable energy sources (RES) led Cyprus to achieve the 13% target in final energy consumption foreseen for 2020 already in 2018; while 2030 goal is within reach according to the National Energy and Climate Plan (NECP)[2].

Nonetheless, the use of fossil fuels still prevails, and the penetration level of renewable energy sources remains low. In a bid to turn things around, Cyprus has stepped up its efforts to achieve the long sought-after clean energy transition.

[2] Cyprus' Integrated National Energy and Climate Plan, 2020. https://ec.europa.eu

On this occasion, the protagonist is Smart PV[3], a LIFE project developed by an almost entirely Cypriot consortium, and led by the University of Cyprus, that aimed at optimising the rate scheme between residential energy producers and the power utility for photovoltaics (net metering scheme). The end goal: to promote higher penetration of renewable energy sources in the country's energy mix.

This project started in July 2013 from the idea of demonstrating the fundamental importance of citizens active participation to achieve relevant levels of energy efficiency. It aimed at developing and validating a cost-optimal scheme that gave prominence to the role of prosumers, together with demonstrating the concrete contribution of market-driven incentives.

How was this realised? The Smart PV project developed a pilot demonstration, analysing the practices of a representative sample of the Cypriot residential prosumers (300 people) who were subject to a newly developed net metering system to design an optimum tariff model. This was the first time ever that Time of Use (ToU) tariffs were used as economic incentives for the participants involved. In other words, by predetermining constant higher electricity prices to peak demand periods, the project nudged prosumers to shift electricity use from peak to off-peak hours.

The tariffs were designed through a questionnaire targeted to all the participants, endorsed by both the local Distribution System Operator (EAC) and the Cyprus Energy Regulatory Authority (CERA). Within the context of the program, the participants received at-home tutorials regarding individual energy profiles and had access to a customised website in which they were able to compare their energy patterns with the ones before the roll-out of the pilot. The result? Actively engaged prosumers shifted their energy demand from peak to off-peak periods, reduced their energy consumption, and saw reductions in their bimonthly electricity bills.

Together with its project partners, the FOSS Research Centre for Sustainable Energy of the University of Cyprus showed that it is not necessary to mobilise huge resources to make an impact. In fact, although rolled out in one of the smallest countries of the EU, Smart PV gained national and international recognisance and won the LIFE Citizen's Prize 2019 and the Cypriot Energy Globe Award 2020.

The outcomes of Smart PV are multifaceted. On the one hand, Smart PV stands out as regulatory sandbox experience: the development and validation of a cost-optimum scheme based on Time of Use tariffs designed in tandem by the Distribution System Operator and the regulator through the active participation of the prosumers. Indeed, the instrument developed by the Smart PV team was made available to achieve a general cost-effective rollout of smart metering tools at national level. Moreover, the gained knowledge can be further maximised through the development of net metering schemes and associated policies in other EU countries.

On the other hand, Smart PV raises as a proof of the importance of people's perceptions, attitudes, and behaviours to materialise the benefits of renewable energy sources. This project managed to incorporate and demonstrate the contribution of market-driven incentives that are not

[3] SMART PV Website: http://www.smartpvproject.eu

only an alternative to costly Feed-in Tariffs (a financial contribution per kWh of energy produced) but that also entail a direct benefit for prosumers which is key to bringing them on board.

Ultimately, Smart PV boosted the penetration of renewable energy sources and paved the way towards a more sustainable electricity grid in Cyprus, actively supporting the national climate targets. But the project also offers us an even more important lesson: that the clean energy transition goes beyond technology readiness and that in the path towards climate neutrality each and every one of us has a crucial role to play.

Webpage

Link

4.2 Czech Republic's state-of-the-art nuclear infrastructure key for European R&D cooperation in the field of low-carbon energy

Written content

The Czech Republic became part of the European Union in May 2004 during the Eastern enlargement. Since then, the country has been able to step up its research efforts and renovate its research infrastructure to bring them into line with European standards and better contribute to the ambitious EU research and development (R&D) objectives. Indeed, according to the 2018 report "SET Plan Delivering Results: The Implementation Plans"[4], Czech Republic is already involved in three Implementation Plans. As per the status of the national low-carbon energy sector, the main renewable sources for electricity generation in Czech Republic are Biomass, Hydropower, Solar PV, and Wind[5]. Nevertheless, nuclear power has been progressively taking a more prominent role: six nuclear reactors generate one-third of the national electricity and the country is committed to expand this capacity in the future years.

From a technical point of view, the research efforts that have led to the progress from one generation of nuclear reactors to another have been guided by the aim of improving, among others, the safety and sustainability of nuclear energy. The main character of this story, the research organisation Centrum výzkumu Řež (CVŘ)[6], has also been a protagonist in the advancement and progress of this energy source through the different reactor's generations.

By becoming a European Member State, a world of opportunities opened for Czech Republic, and CVŘ tapped into the available funding programmes as a launching pad to strengthen the research, development, and innovative potential of the country in the nuclear sector. By so doing, the country became an even more relevant actor in nuclear research activities in Europe. As part of this process, CVŘ, together with the University of West Bohemia, deployed the Sustainable

[4] *SET Plan Delivering Results: The Implementation Plans*, SETIS, 2018. https://setis.ec.europa.eu
[5] *National Energy and Climate Plan of the Czech Republic,* 2019. https://ec.europa.eu
[6] CVŘ Website: http://cvrez.cz/en/

Energy Project (SUStainable ENergy, SUSEN)[7], an initiative funded through the European Regional Development Fund.

Within the SUSEN framework, two modern research sites were built, including a new diagnostic centre in Řež and a new experimental hall in Plzeň. Additionally, five other existing building areas were rebuilt and renovated to accommodate new technologies. Moreover, this multidisciplinary project was divided into four programmes dedicated to key aspects of nuclear technology, such as the development of more sustainable, efficient, cost effective, and safer Generation IV reactors; the evaluation of residual lifetime, reliability, and safety of Generation III reactors; the development of innovative radioactive waste processing (disposal or recycling); and the evaluation of the properties of new advanced materials under extreme conditions.

The infrastructures developed within the SUSEN project were all completed between 2013 and 2015. Nonetheless, the outcomes of the SUSEN project are of far-reaching significance. First of all, the laboratories have been further employed for research purposes in the framework of the follow-up project Research for SUSEN, funded via national programmes. The SUSEN infrastructure has also been made available for researchers from academia, business, industry, and the European Research Area (ERA) countries, reinforcing close working relationships and granting them the possibility to draw upon state-of-the-art instrumental technologies. Likewise, several international projects have been developed within the SUSEN grounds, bringing the country and CVŘ forward in a competitive research environment.

Ultimately, and as if the above were not enough, the Centre is also focusing on non-nuclear application of the SUSEN infrastructures, with the aim of applying the results in the sustainable energy sector. Indeed, researchers are investigating the possible uses of the heat produced by nuclear processes, other than in conventional electric power generation. One possible way to employ this power is in the production of hydrogen, which can serve as an alternative energy carrier to conventional fossil fuels, a European priority on its path to carbon neutrality.

In essence, this tale portrays CVŘ efforts to establish a roadmap on the ambitioned Czech Republic's research and development landscape in nuclear energy, by ensuring top-class research infrastructures that aim at putting the country at the forefront of the Union's expertise in the field. In addition to the preeminent place SUSEN occupies for having developed newer and safer technological instruments to deploy nuclear in a more sustainable and secure way, the project also represented a major step forward for R&D infrastructure in Central Europe and crystalised the importance of aligning national research priorities with European main concerns.

But over and beyond the above, SUSEN continues to foster collaboration among researchers supporting the exchange of know-how and best practices, contributing to boost a real European research environment, and creating opportunities for synergies that could also be extended to other clean energy technologies, all key factors to increase competitiveness in a globalised environment and to reach the longed-for goal of climate neutrality.

[7] SUSEN Website: http://susen2020.cz/en/

Webpage

Link

4.3 Technological breakthroughs reach industrial scale in Estonia bringing them closer to climate neutrality

Written content

The Republic of Estonia became a European Union member in May 2004. Since the integration into the common economic bloc, this dynamic Baltic country is characterised by an impressive economic growth rate, twice as rapid as the EU average, that translates into an increasing need for energy to power their growth. Though it is true that currently most of the Estonian electricity generation stems from the domestic production of oil shale (~70%), the share coming from renewable energy sources (RES) is constantly increasing[8]. Moreover, according to the 2018 report "SET Plan Delivering Results: The Implementation Plans", Estonia participates in two Implementation Working Groups: solar photovoltaics and concentrated solar power.

The main sources of clean energy in Estonia are biofuels and wind, each of them accounting for approximately 17% and 9% of the electricity generated in 2018. Moreover, in line with the country's thriving environment for research and innovation, Estonia is also exploring other technologies such as solar photovoltaics (Solar PV) whose installed capacity has enlarged fivefold in the last four years. However, the traditional silicon solar cells by which the photovoltaic market is dominated, and that were first introduced back in the 1950s, are still resource intensive, while obstacles related to reflection and absorption losses and efficiency issues remain. The endeavours undertaken by the protagonist of this story in its effort to answer these challenges are at the core of this piece.

Tallinn University of Technology, or simply TalTech[9], a technological university in Estonia and the driving-force behind the country's research in photovoltaics, is currently focusing on the development of the next generation of solar cells. In order to make solar energy widely available, researchers at TalTech are working on low-cost, simply produced, and versatile solar cells, that aim at changing the prospects for photovoltaics in Europe and beyond.

The work is organised into two research groups constituted by three laboratories: on the one hand, the laboratory of thin film chemical technologies; and on the other, the laboratory of photovoltaic materials research and the laboratory of optoelectronic material physics. Even though they focus on the development of different technologies, both pursue the very same goal: to obtain simpler and more cost-effective technologies that enable versatile applications, smoothing the transfer from laboratory scale to industrial scale.

The combination of approaches of a prominent group of researchers from the laboratory of photovoltaic materials research and the laboratory of optoelectronic material physics has resulted in the development of a ground-breaking technology: thin-film solar cells based on a compound

[8] *Estonia's 2030 National Energy and Climate Plan,* 2019. https://ec.europa.eu
[9] TalTech Website: https://www.taltech.ee/en/

semiconductor with very good light-absorbing properties called kesterites. Besides this characteristic, which is crucial for the development of thin layers, kesterites also contain earth-abundant and low-cost chemical elements, key for addressing the materials scarcity issue that surrounds photovoltaic technologies.

Moreover, to produce these semiconductors, TalTech researchers use a unique technology, monograin powder technology, which differs from others used in terms of its method and the fact that it is cost-effective. Monograin powder technology also enables semi-transparent, lightweight, and flexible PV modules. Such properties are central for developing integrated applications of photovoltaics into building envelopes (roofs, windows, facades, etc.).

Besides the disruptive technologies that position TalTech at the forefront of innovation in solar PV, efficiency has been the compass steering its activities. This indicator, which is one of the most relevant for the quality of photovoltaics, has also been the cornerstone of its well-oiled research-industry collaboration. In fact, the technologies developed are to be produced at industrial level and commercialised by its spin-off company Crystalsol[10], a joint venture launched in coordination with Austria in 2008. Thanks to this collaboration, Crystalsol will develop an entirely new type of flexible, lightweight, and even semi-transparent photovoltaic film with significant cost and versatility advantages for a range of possible applications, from building integrated photovoltaics to consumer products.

TalTech tireless efforts for bringing its research closer to industry have not stopped there. Its undisputed leadership in the next generation of photovoltaics has earned them a place in several European projects. The most recent, CUSTOM-ART[11], aims at bringing flexible and semi-transparent solar modules from a Technology Readiness Level (TRL) 4-5 (technology validation) to TRL 7-8 (prototype demonstration). In the long run, the project will impact aspects such as conversion efficiency, durability, costs, and sustainable and abundant materials, that are key to ensure the viability and competitiveness of the European Building Integrated and Product Integrated Photovoltaics industries (BIPV & PIPV).

Ultimately, TalTech story is not only one about technological breakthroughs. It is the chronicle of a front runner centre with strong research and innovation capacities, which has been able to understand the national research environment first and the European thereupon, while building its own strengths to address the identified challenges. TalTech has also been able to defy the common belief that most research efforts stay in the laboratory and rarely reach the market by taking a leap and bringing its own close to commercialisation.

The highlight of this tale can be summarised in a relevant lesson: Research-industry close collaboration is a critical component of the innovation process and a frequent and iterative interaction among these actors lays at the centre of an effective energy transition if Europe aims to reach its climate goals. In this light, TalTech can be seen as a prime example of innovation and

[10] Crystalsol Website: https://www.crystalsol.com/
[11] CUSTOM-ART CORDIS Webpage: https://cordis.europa.eu/project/id/952982

industry uptake of new technologies that will undoubtedly help put the continent on the right track towards carbon neutrality.[12]

Webpage

Link

4.4 Poland strives to become a leading player in the hydrogen sector materialising long-term efforts

Written content

Poland, a Member State since 2004, is the eight economy within the EU, and according to its National Energy and Climate Plan (NECP), it has the sixth highest volume of primary and gross energy consumption in the Union. The local electricity production deriving from coal mines provides Poland with a certain degree of independence and stability. Nonetheless, in the period between 2010 and 2018 installed Renewable Energy Sources (RES) capacity increased four times and RES electricity production doubled[13], providing an indication of the effort the country is making to set the bases to facilitate the transition towards a more sustainable energy model. In this light, Poland has also joined two SET Plan Implementation Working Groups, 'Energy efficiency in industry' and 'Nuclear'[14].

This story begins with one of the main trade-offs each society faces as they develop: national economic growth goes hand in hand with additional energy consumption, and Poland is not the exception. However, the most used energy sources are based on fossil fuels that have the dual disadvantage of being both finite and polluting, and therefore not sustainable in the long-term. As a result, governments, the industry, and the scientific community are looking into alternatives based on clean and renewable energy sources.

One of the most promising energy carriers, on top of being environmentally friendly, is hydrogen. As pure hydrogen does not exist freely in nature; it must be generated either from hydrocarbon-based gases or from natural sources. Although there are three primary techniques used to produce hydrogen from hydrocarbon fuels, none of these processes are qualified as clean. Therefore, the development of clean, or also called green, hydrogen technologies have become key to achieve the sustainably goals set by the EU. As a mark of its commitment, the European Commission has adopted a new dedicated strategy on hydrogen with the aim of exploring its potential to support decarbonisation objectives in a cost-effective way.

One of the technologies currently in use for the generation of clean hydrogen is steam electrolysis, which consists in producing hydrogen from water at high temperatures. In recent years, steam electrolysis based on Solid Oxide Cells (SOC) proved to be an optimal solution, due to high

[12] For additional information about energy research activities in Estonia please visit the following website: https://researchinestonia.eu/
[13] *National Energy and Climate Plan for 2021-2030,* 2019, https://ec.europa.eu/energy/sites/default/files/documents/pl_final_necp_part_1_3_en.pdf
[14] *SET Plan Delivering Results: The Implementation Plans*, SETIS, 2018. https://setis.ec.europa.eu/sites/default/files/setis%20reports/setplan_delivering_results_2018.pdf

efficiency of conversion and relatively low costs. This is one of the reasons why Solid Oxide Cells operating as electrolysers are being internationally recognised and currently under intensive development. The Institute of Power Engineering (IEn)[15], the protagonist of this success story, and one of the largest institutes in Poland and Central Europe working on energy research, has been actively involved in the advancement of this technology.

More specifically, the Institute of Power Engineering is the holder of a patent portfolio and technology of Solid Oxide Electrochemical Cells that has been under development for 16 years. As a result of its rigorous research, the portfolio has reached performance levels of electricity generation corresponding to state-of-the-art technology, becoming a highly relevant milestone for hydrogen deployment, not only at European level but also worldwide.

On top of the role IEn has played in the development of such technology, it has also been actively involved in promoting the concept of sector coupling in Poland. Indeed, steam electrolysis is the most widely used solution in Power-to-X systems for sector coupling which refers to the process of electrification of end-use sectors like heating and transport, with the aim of increasing the share of renewable energy in these areas, ultimately cutting emissions, and contributing to the sought-after goal of climate neutrality. Over and above that, IEn's efforts have led to the launching of the recently established Centre for Hydrogen Technologies (CTH2), composed by a team of experts coming from a wide range of engineering disciplines, and whose purpose is to support research and development activities on the deployment of fuel cells and electrolysers with the aim of developing a strong tie with the market and the industrial sector.

In the framework of the European effort towards the development of a sustainable energy system, capable of supporting the ever-growing demand, IEn has been able to identify the role it can play by taking a clear stand on its research and innovation priorities. The Institute has not only been at the forefront of the development of the novel green hydrogen sector, a technology that has become fundamental for the achievement of the net-zero emissions target set by the EU, but it has also tirelessly worked to grow into one of Poland's most outstanding scientific and technological centres. This has positioned them strategically to take an active role in numerous topical EU-funded projects such as BALANCE, HyLAW, NewSOC, ONSITE, SOFCOM, FC DISTRICT, and FC-EUROGRID.

Being able to understand the national research landscape and match it with the European energy and climate priorities lies at the core of the successful approach that the Institute has taken towards the opportunities that the Clean Energy Transition opens for Poland. In IEn's case it meant the development of innovative technologies that will play a key role in paving the way not only of the country but also of Europe towards climate neutrality in 2050. Even though this story started 16 years ago with the decisions IEn made back in the days, it has never been more relevant to say that the best is yet to come for Poland and the pivotal role it is being called out to play in this cause that concerns us all.

[15] IEn Website: https://ien.com.pl/home

Webpage

Link

4.5 Budapest University of Technology and Economics (BME) shows how success rates in research programmes start by knowing yourself: the Competence Map case

Written content

Budapest University of Technology and Economics (BME) shows how success rates in research programmes start by knowing yourself: the Competence Map case

Hungary is at the forefront of the Eastern Europe energy sector: not only it became one of the first countries in Central Europe to put a carbon neutrality goal for 2050. In the last few years, it has rapidly increased its share of renewable energy sources in gross final energy to reach 12.6% in 2019 and 13.9% at the end of 2020, exceeding the 13% target that Hungary had for 2020. At the centre of these efforts is the Budapest University of Technology and Economics (BME), one of Hungary's leading academic institutions, representing the country's oldest technology university and an excellence centre today. Nonetheless, it suffers from the same issues that struck the youngest EU Member States (informally known as EU-13 countries): low success rates in the EU Research Framework Programmes.

To address this situation, BME has created a specific instrument to catalyse opportunities and help researchers show their potential: the BME Competence Map. This Map aims to promote practices to facilitate researchers' successful participation in Horizon Europe. The young initiative, presented officially in May 2022, is an up-and-coming force at BME with a small but dedicated team. Its cornerstone is to be proactive and maintain a dynamic interaction with its researchers.

According to Dr Borbala Schenk, the BME Competence Map editor, researchers need five types of support when applying to programmes like Horizon Europe. These go beyond the simple excellence of the idea, and entail understanding better what the funder is looking for, support in searching valuable partners, navigating the information systems, finding the right grand and the confidence to pursue new solutions. Still, the Competence Map was born with another goal in mind: to change the way success is measured in research funding. If Horizon is taken as an example, it is not only about funding but mostly about participating in research discussions with academia, industry, and public bodies. "When you enter a consortium, even if you are only leading a task, you are part of a group of people developing innovative concepts. When you enter the scene, it is already a success". Dr Schenk believes that there is a lot to learn from rejected proposals. The low success rate does not explain everything: according to experience, if you position yourself as a credible partner, even if a proposal does not get funded you will be invited to other cooperations.

Here comes the value of initiatives like the Competence Map. Starting from the initial idea to the proposal submission, the team provides a whole complex set of services to researchers according to their needs. Dr Schenk defines the consultation phase as crucial, comprising information and

awareness raising: “What we do is we consult with researchers and groups, create tailor-made advice for them, we scan their expertise and research interest, and we approach them with the possibilities that fit them best”. She even suggests that the initiative may change names: “it is not about competences but about the value propositions that research groups can present, not only to academic partners but also to potential industrial partners”.

The way the Map works is quite simple in its concept. The team gathers information from researchers and research groups, including their areas of excellence and desired areas of study/partnership. This module is growing fast: in October, there were 132 research group profiles and 380 researchers; 3 months later, it shows 147 research groups and 420 researchers. The people behind the Map then actively promote the content available: they provide LinkedIn articles, YouTube videos, and Facebook posts: "it is an important tool to show the world what our researchers know", Dr Schenk says. The Map has a search option based on 33 keywords covering Horizon topics and the university's expertise.

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4.6 Research into policy and policy into practice: How the work of a Latvian university promoted concrete changes in the national electricity market

Written content

Over the last decades, Latvia has been able to become a leader in the EU when it comes to renewable energy and energy efficiency. The country is the second greenest in the EU based on CO_2 emissions and has more than 2000 specialists employed in the field[16]. Data from 2019 shows that Latvia had the third highest share of renewable energy sources (RES - 40.97%) in energy consumption in the European Union (EU) after Sweden (56.4%) and Finland (43.1%)[17].

Hydropower is the largest renewable energy source, with 97% of the total production and the remaining 3% divided between wind and biomass[18]. The Baltic country participates in the SET Plan and is present in five IWGs (Positive energy districts, Energy systems, Energy efficiency in buildings, Energy efficiency in industry, and Batteries). In 2019, the Latvian government set ambitious targets in the NECP regarding the share of energy produced from RES in gross final energy consumption, aiming to reach 50% of the energy produced from RES by 2030.

While the current energy situation is auspicious, there is still an untapped potential that can be realised thanks to R&D in renewable energy sources in Latvia. As more intermittent renewable power sources (e.g., wind and solar) are introduced into the power system, this creates new challenges for both the power system operators and the electricity market participants. On the one hand, the unpredictability of intermittent generation forecasts significantly impacts electricity

[16] InvestinLatvia website: “*Latvia – the best location to invest in smart renewable energy*” https://investinlatvia.org

[17] Eng.LSM.lv (Latvian Public Broadcasting): *"Latvia third in EU for renewable energy use"* https://eng.lsm.lv

[18] Scanbalt website: "*Green Tech; Latvia one of the leading European Countries in Renewable Energy Sources"* https://scanbalt.org

prices. On the other hand, developing new sources also opens up new potential research topics, such as energy utilisation, generation and demand side flexibility, advanced forecasting techniques, and improved energy system modelling.

To provide a partial solution to this problem, the RTU Institute of Power Engineering at the Riga Technical University developed a software toolset for modelling, control, and planning of energy systems aiming at decreasing energy prices both for individual electricity wholesale market participants (e.g., storage and generator operators), and to end consumers at large. The software also aims to assist policymakers in their decision-making and reduce state support for renewable energy plants. These topics aim to increase the efficiency of electricity market operations, albeit from different perspectives.

In particular, the institute proposed and tested various methods and algorithms that storage operators can use to participate in an electricity spot market effectively, particularly regarding the peculiarities of large-scale energy storage technologies, cascaded hydropower plants, and heating demand forecasting. As for policymakers' assistance, decision-support is realised in the form of modelling, assessment, and recommendations related to the influence of large cogeneration plants on the electricity market and, subsequently, the options to change the support these plants are subjected to.

The toolset was developed in contract work for Latvenergo AS, a Latvian electricity and thermal energy generation and supply company. It included various modules, including "OptiBidus-HES" for cascaded hydropower plant modelling and "OptiBidus-TEC" for heating demand forecasting to support the decision-making process of combined heat and power plant operators. The real benefits of the optimisation software are multiple. For example, the toolset enables efficient planning and operation of production and distribution and increases supply security for heat customers. Moreover, more accurate forecasts can reduce CO_2 emissions due to more efficient planning and operation of production assets and heat distribution networks.

As for policymakers support of power plants, RTU's research found that it is possible to reduce to 75% of the current level or application of payment correction without endangering the feasibility of continued power plant operation. In addition, the research authors concluded that the model could be further used for research purposes by incorporating it in large power system models or, with some modifications, more directly in reserve provision assessment. In this way, it could be possible to balance demand and supply at all times and address different sources of uncertainty inherent to electricity systems, such as forced outages and forecast errors[19].

The developed toolset was also widely used for scientific purposes: the authors participated in multiple conferences, and the research results have been published in numerous peer-reviewed scientific publications. Even further, the results of the electricity market price and combined heat and power plant support analysis were integrated by the Ministry of Economics of Latvia in their "Conceptual Report on Complex Measures for the Development of the Electricity Market".

[19] Van Der Bergh K. and Delarue E., Energy and reserve markets: interdependency in electricity systems with a high share of renewables, Energy Institute – KU Leuven

Following the conceptual report, significant changes were made to the capacity payment system in Latvia.

In conclusion, this tale shows the great potential for further research in energy system modelling in Latvia to address the inherent uncertainties of electricity markets based on renewable energy sources and decrease electricity prices for different stakeholders. In fact, through the examples presented in this story, it is clear that applying well-functioning decision-making support methods, algorithms, and tools by power plant operators and policymakers can bring about several benefits from efficient electricity market operation to individual electricity wholesale market participants and to the end-consumer at large.

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4.7 Lithuania's pursuit of excellence in bioenergy brings the country forward in the European low-carbon energy scene

Written content

Since it joined the European Union in 2004, Lithuania has boosted the already ongoing transformation of its energy sector in pursuance of energy security and independence, as well as to align it with the European energy strategies and policies. With the decommissioning of the Ignalina Nuclear Power Plant in 2009, Vilnius has increased its reliance on renewable energy sources – the principal being bioenergy – and shifted from a net exporter to a net importer role in terms of electricity.

The Lithuanian National Energy and Climate Plan (NECP) has traced an ambitious path towards 2030, reducing emissions by 55%, increasing the share of renewables in the final energy consumption to at least 45%, and raising the percentage of domestic electricity production to 70%[20]. The biggest of the Baltic countries participates in the execution of the SET Plan, namely in the Implementation Working Groups on Batteries and Nuclear safety. Cooperation with the latter is broadly addressed in the NECP, which identifies the alignment between nine thematic areas of the SET Plan and the respective national targets for Research and Innovation (R&I) in the energy sector[21].

Lithuania's success story traces back to 1990, when the independence ignited the process of transformation of the energy sector. Thereafter, Vilnius sought to emancipate from natural gas imported from the Russian Federation and pursue energy independence through bioenergy and waste for co-generation and heating. More shows that natural gas went down from 61% of the total heat generation in 2000 to 18% in 2019, while bioenergy and waste increased from 3% in 2000 to 56% in 2019. Today, roughly 75% of the entire heating is generated through the

[20] Lithuania's Ministry of Energy. 2019. National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030.
[21] European Commission. 2020. Assessment of the final national energy and climate plan of Lithuania, page 12.

combustion of woody biomass harvested in Lithuania or imported from the Belarussian side of the regional Baltpool platform[22].

Acknowledging the role of Lithuanian forests as a major carbon sink and hence a key resource to achieve 2030's emissions reduction targets, together with the growing concerns over deforestation in the neighbour Belarus, Lithuania has bet on modern forms of bioenergy such as Waste-to-Energy (WtE) and Power-to-X (PtX)[23]. Through such technologies, Lithuania aims at transforming waste into alternative fuels and hydrogen. More specifically, waste material not suitable for recycling but still possessing energetic value (e.g., municipal solid waste (MSW), refuse derived fuels (RDF), solid recovered fuels (SRF)) can be utilised for energy, fuel or chemical production through thermochemical pathways.

The Lithuanian Energy Institute (LEI)[24], an energy-related research and technology competence centre established in 1956, emerges in this context as the main character of this story. LEI is a state budgetary institution playing a key role at a national level by contributing to drafting national energy strategies and bridging the government and the industry in overarching research projects. Over and above, it is also actively involved in international cooperation with other research institutions as its numerous participations in international initiatives, included several Horizon 2020 projects, account for.

Among these is TWIN-PEAKS (Twinning for Promoting Excellence, Ability and Knowledge to develop advanced waste gasification Solutions)[25], a Horizon 2020 project coordinated by LEI, aiming to foster the uptake of Waste-to-Energy research and innovation in Lithuania and to engage the country in pan-European collaborative efforts on this matter. More in detail, through TWIN-PEAKS, LEI and the Vytautas Magnus University (VMU) are working together with two other partner research organisations from Germany and one from Sweden. The objectives are to develop a joint-research strategy, pool their research infrastructure, transfer scientific knowledge and know-how on WtE R&I, trace academic and non-academic networks, reach out to end-users of WtE solutions, and plan for joint applications for research grants to fund further research projects involving the consortium. Ultimately, TWIN-PEAKS is expected to increase the research excellence of LEI and VMU, enhance their international ties, and grow opportunities for collaboration with the industry in the field of WtE.

The success of the TWIN-PEAKS project lies in the many years of research and expertise that LEI has developed in the field of biomass usage and energy production and the related network of infrastructures and labs. According to LEI's director, Dr Sigitas Rimkevičius, among the most relevant services provided is research on the identification of biomass fuel characteristics, research on combustion processes and the reduction of environmental emissions, and safety assessment and waste management at nuclear power plants. An example of LEI achievements in the field of thermal treatment of biomass and waste is the EUREKA project that led to the development of a prototype of gasification equipment automatically operated. It can regulate and

[22] International Energy Agency. 2021. Lithuania 2021, Energy Policy Review, 56.
[23] Ibid., 11-12.
[24] Lithuanian Energy Institute. https://www.lei.lt/en/.
[25] TWIN-PEAKS. "About TwinPeaks". https://www.twinpeaks-h2020.eu.

adjust the gasification process to different types of fuels and generate gas that is later supplied to internal combustion engines or turbines that generate electricity or thermal energy.

It is also undeniably thanks to its laboratories and their specialised technological equipment that LEI was able to position itself as a key stakeholder in this field. Among these are the Laboratory of Plasma Processing and the Laboratory of Combustion Processes. A wide gamut of research is conducted in the former, for example, about plasma sources, diagnostics of plasma flows and jets, analysis of gas dynamic characteristics, and heat-mass transfer[26]. The latter, created more than twenty years ago, is specialised in heat and mass transfer, combustion and gasification, and environmental impact assessment[27].

A clear understanding of the country's national priorities regarding energy security and the effort to align them with the European Energy Security Strategy is undoubtedly one of the critical elements of this success story. Other crucial aspects are the many decades of expertise and efficient technological facilities in place at the Lithuanian Energy Institute, together with the strong international ties and cooperation with other research and technology organisations within the European Union. Lithuania is well aware that by taking part in collaborative projects such as this as well as in the vast array of SET Plan initiatives, it can successfully develop the sought excellence in R&I.

In conclusion, LEI and the TWIN-PEAKS project show the importance of aligning with both national and European priorities and joining forces with partners from across the continent to take advantage of the many opportunities arising from international cooperation and participation in the SET Plan.

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4.8 A vitalising effort to bolster photovoltaic research in Malta

Written content

Malta's lack of fossil fuel sources or gas distribution networks means that the country relies strongly on imports of fossil fuels and electricity to cover its energy needs. Since 2015, Malta has been connected to the European power grid, through which it imports a considerable share of its electricity. Additionally, it has attempted and succeeded in increasing its share of energy from renewable sources, though it fell short of the 10% target it had set for 2020. Nonetheless, the increase from 4.4% in 2015 to 8.2% by 2019 was largely a result of the adoption of solar energy. This source accounted for more than 97% of the total renewable production in Malta in 2019. That was followed up by additional policy initiatives to subsidise and promote the installation of solar panels in residential, commercial and public spaces.

[26] Lithuanian Energy Institute (lei.lt): "*Plasma Processing Laboratory (15)"* https://www.lei.lt
[27] Lithuanian Energy Institute. "*Laboratory of Combustion Processes*". https://www.lei.lt

In that context, the JUMP2Excel project (Joint Universal activities for Mediterranean PV integration Excellence), funded by Horizon 2020 and coordinated by Malta's College of Arts, Science and Technology (MCAST), stood out as a vital effort in the endeavour towards realising the potential Maltese attribute to current and future PV research. From 2018 until 2022, JUMP2Excel aimed to step up and stimulate the scientific excellence and innovation capacity of MCAST Energy in the field of PV integration, including related technologies such as energy storage and ancillary services and electricity markets. This achievement was possible thanks to joint activities with a group of top world-leading research centres (CENER and CEA) together with one of the best research-intensive universities (UNIMAN), which provided access to an extensive network and contacts in the field. The activities consisted mainly of knowledge transfer and networking through a series of workshops, winter/summer schools, MRes (Master of Research) and PhD programmes, internships, exchanges, meetings and mentoring.

With the main focus being PV research, particularly towards establishing MCAST Energy as a regional leader in cooperation with world-leading research groups, the following objectives were established:

- To enhance and increase the research output of MCAST Energy (in quality and quantity).
- To increase the success of MCAST Energy in grant applications and recruitment of excellent personnel.
- To strengthen and develop long-term relations between MCAST Energy, partners, networks and stakeholders.
- To increase the international standing of MCAST Energy, acting as a regional hub in the field of PV, relevant technologies and electricity markets.

The project developed an interface between scientific output and the market to stimulate economic growth in many areas, increase the possible emergence of local industry in the field, and potentially attract new sources of international investment to the island. Moreover, JUMP2Excel was designed to benefit all partners in a way that went sustainably beyond the three-year funding period. This approach is meant to result in enhanced skillsets and profiles for MCAST Energy, which in turn should reflect the positive development of Malta's knowledge economy, including its ambition as a regional energy hub, solar country and blockchain state.

Even though social benefits derived from energy projects of this nature are not immediate, as they tend to manifest in longer timeframes and often depend on additional contextual variables, the project still concretely succeeded in achieving the abovementioned objectives. Additionally, potential impacts of the project included targeted PV energy integration research with synergies between academia and enterprises, encouraged the training of enterprises and policymakers, reduced CO_2 emissions, and intensified efforts in the research field, amongst others.

The project also resulted in the publishing of several research papers, as well as the organisation of events and conferences, which have fostered the sharing of knowledge and experiences. This, alongside the other project's activities, has stimulated the research and innovation capacities of MCAST and, subsequently, it is an effort that may prove to be vital to boost Malta's role as a regional hub in the field of solar energy.

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4.9 Slovenian researchers join forces to enhance the country's ability to implement sustainable energy management

Written content

Despite being one of the smallest countries in the European Union (EU), Slovenian researchers have shaped this potential liability into a strength. Slovenia ranks on top of most EU-13 peers regarding Framework Programme 7 (FP7) results[28] in terms of success rates, and the country is also part of the Strategic Energy Technology Plan (SET Plan) of the European Commission. In the SET Plan framework, Slovenia is active in two of the 14 SET Plan Implementation Working Groups (Batteries and Nuclear Safety). The country's good performance arises as an astounding achievement when considering that the government expenditure in research and development (R&D) activities totals only 0.30% of Slovenia's GDP[29].

Many reasons can explain this good performance, and the University of Ljubljana is a primary example to shed light on the dynamics of collaborative research in the country. Stemming from the university's Faculty of Mechanical Engineering efforts, the Research Programme (RP) Energy Engineering is a project focused on holistic research activities in the field of sustainable energy management.

The RP was first started in 1999, initially for a period of four years, and was then renewed four times until today. The idea behind the RP was to develop innovative basic and applied scientific contributions, which could be then implemented in the Slovenian market and society for the benefit of its industry and citizens. The nature of the programme is not simply interdisciplinary but also inter-institutional, as the University of Ljubljana has cooperated over the years with leading national and international institutes to carry out its research activities and implement its results.

The scope of the RP is wide-ranging, addressing multiple R&D activities in energy and process engineering, ranging from design and optimisation of components to optimising energy systems. To overcome the barriers preventing research from spilling over to the market, the RP has developed a series of industrial projects that aimed at enhancing innovation both inside and outside the countries involved. The projects concerned Slovenian local partners and a constellation of leading international players (among others Akrapovič, Danfoss Trata, Alstom, Philips, AVL, and Andino).

The interaction with industrial partners has proved to be successful for the University of Ljubljana. Not only did the researchers involved in the RP applied or gained patent rights for over 30 applications overall, but they also established long-term, stable contacts with the national industrial sector. This antecedent is a crucial achievement for any EU country, where the connection between research and industry still struggles to find a common deployment

[28] Florin Zubașcu (2017) "*R&D in the East: Enthusiasm goes a long way in Slovenia*" https://sciencebusiness.net
[29] stat.si website: https://www.stat.si

framework. The RP also contributed to connecting companies with other companies, not only researchers, increasing the networking activities in the country. Examples of the fruitful collaborations are the RP-led developments of prototypes:

1. Software code built into AVL simulation packages
2. A wastewater treatment device on the principle of hydrodynamic cavitation
3. Custom designed acoustic cameras for noise source (household appliances, industrial and environmental use) identification and classification including psychoacoustical analysis

The tremendous success of the RP, nonetheless, remains to be the advancement of collaboration between researchers. Scholars participating in the RP acted over the years as advisors to more than 30 PhD students, in addition to around 400 Master's and bachelor's students. In this way, the RP has kept as its primary objective to complete the triple helix of university-industry-government relationships in the country, crucial to fostering its innovation ecosystem.

The collaboration has yielded results in the application to EU funding programmes as the FP7 (examples of projects developed cooperatively in the RP are FLUMABACK[30] and CROPS[31]), but also in the participation to international organisations, including EARPA (European Automotive Research Partners Association), EGVIA (European Green Vehicle Initiative Association), and EAA (European Acoustic Association). The RP has also successfully consolidated its role thanks to its participation to other also outstanding EU programmes such as LIFE (SustainHuts), COST (CA20138), EIP Agri (The implementation of new mechanical and autonomous automated technologies for the sustainable production of grapes in vineyards), EIT InnoEnergy (CTProfiler), ESSR (IQ Home, CoNot), ESA (CryoCav), Eureka (MSASN)...

In addition, researchers from the University of Ljubljana were ERC Consolidator Grants winners in 2017 and participate in the Austria-led COMET K2 Funding Program of the K2 Center "Integrated Computational Material, Process and Product Engineering (IC-MPPE)". Moreover, they played a leading role in developing action plans of the Slovene Strategic and Innovation Partnerships established within the EU's Smart Specialisation Strategy.

Ultimately, the consolidation of this programme in the framework of the University of Ljubljana's activities can be taken as a positive example, showing how the laboratory-to-market gap can be closed. To achieve this goal, a solid and clear framework must be established, and the RP can lead the way for other EU-13 countries in adopting strategies to increase the impact of research on society.

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[30] cordis.europa.eu: https://cordis.europa.eu
[31] cordis.europa.eu: https://cordis.europa.eu

4.10 A new concept for electrolyser set to bring Romania and the EU closer to hydrogen targets

Written content

Romania is a major player in Eastern Europe, being the most populous country after Poland and one of its largest economies. Romania is also a highly industrial country, with the sector producing almost 30% of the nation's GDP. To decarbonise its industry, Romania will be in high need of hydrogen in the future: still, the country has yet to catch up. Its official hydrogen strategy has only come around these years, developed in the scope of Romania's National Recovery and Resilience Plan. According to its provisions, the country will target the construction of electrolysers capacity of at least 100 MW by the end of 2025, producing at least 10,000 tonnes of hydrogen per year. At the same time, studies based on the EU "Fit for 55" package proposals on hydrogen use show that an electrolysis capacity between 1,470 MW and 2,350 MW should be installed in Romania by 2030.

In this sense, the participation of the Universitatea Politehnica Timișoara in the consortium of the project "PRETZEL - novel modular stack design for high PREssure PEM water elecTrolyZer tEchnoLogy with wide operation range and reduced cost" can be seen as an important step towards the development of a hydrogen ecosystem in Romania. The project's main goal was to develop a new technology for Proton exchange membrane electrolysis (PEMEL), indicated by the EU through its Fuel Cells and Hydrogen Joint Undertaking (FCH JU) programme as the "preferred technology" for the future. The reason is that PEMEL facilities, at the dawn of the project, could not reach the goals set by the FCH JU in terms of cost, efficiency, lifetime and operability.

From its beginning, the project had two main challenges to solve: first, the capital expenditure (CAPEX) reduction through the reduction of critical raw materials use, and second, the increase of the operating pressure to reduce mechanical compression requirements. The PEMEL technology was treated as an up-and-coming hydrogen production system, competing with alkaline electrolysers. These enjoy reduced implementation costs, not only due to higher system efficiency but also to the possibility of operating at higher pressure. To catch up, PEMEL technology needed to demonstrate the ability to reduce raw materials deployment through high production rates at reasonable cell voltage. In addition to solving these issues, the PRETZEL concept also took care of stack components such as the membrane electrode assembly (MEA), the porous current distributor (PCD) and the bipolar plates to be mass- produced and designed with cost-saving measures.

An example is the development of pole plate corrosion protection design: different approaches for corrosion protection at the oxidizing environment present at the anode side of polymer electrolyte membrane (PEM) electrolysers were discussed in the consortium. The simplest solution, a thin titanium foil was taken as a fallback option due to the additional contact resistance between the foil and the copper pole plate. Also, the ultimate goal was to create a corrosion-protective layer for the copper pole plates without the need for precious metals. This way, a structure was developed with niobium as a protective layer combining both desired properties for stability and conductivity. With a Nb-multilayer applied by vacuum plasma spraying, the coating

showed excellent stability, as validated by several corrosion measurements. The Universitatea Politehnica Timișoara played a key role in this process, being dedicated to the evaluation of corrosion resistance and leading the work on compliance testing and characterisation.

By looking at the project results, it could be safely stated that it succeeded. A fundamental goal was to "design and manufacture a 25 kW PEMEL stack that reaches an operating temperature of 90°C, pressure of 100 bar and current density of 4 A/cm² (6 A/cm² in overload mode) while maintaining above 70 % efficiency and fast system response times". The target was reached, as testified by the development of several PEMEL components and a stack design based on hydraulic compression. The project implemented a patented design approach based on hydraulic cell compression, allowing for large planar cell components and effective cooling at very high production rates and temperature levels. These results have since been published in scientific journals, and, most importantly, the innovations produced have successfully made their way over to the commercial world, putting Romania on the roadmap of hydrogen development.

UPT is further actively involved in several other PEMEL research initiatives. One of them is the "CoDe-PEM - Combinatorial Design of Novel Bipolar Plate Coatings for Proton Exchange Membrane Electrolyzers" project, a partnership with SINTEF Industry Norway funded by the EEA Grants 2014–2021 (EEA RO-NO-2018-0502), aiming to contribute towards the development of affordable PEMEL systems by creating less expensive coating materials for bipolar plates and sinters.

Participation in the PRETZEL project brought UPT the perspective of collaborating in a consortium with experts from research institutes, small and medium enterprises and also large industrial partners. UPT shared its expertise in materials testing and characterization, developing new testing protocols for the corrosion resistance of materials used in PEMEL. Working in a highly motivated and efficient team provided the university with many benefits, including access to a wide range of expertise and opportunities for networking and collaboration, leading to new research ideas, joint publications, and potential for future collaborations. These are essential factors for a higher education institution to stay at the forefront and have a significant impact in advancing knowledge.

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4.11 Addressing the shortage of skills for the energy transition: the Slovak Technology University in Bratislava (STUBA) efforts for energy efficiency re- and up-skilling

Written content

Slovakia joined the European Union in 2004, a year that signalled one of the most extensive enlargements of the bloc. Slovakia was and remains a highly industrial country, with this activity representing 24.1% of the total economy's value. At the same time, the country's industry is highly energy intensive: Slovakia's energy intensity has decreased until 2020, when it started to rise again, and places itself seventh in the EU as the most energy intensive country. In this light, the

efforts that Slovakia must put in place for the energy transition are not only technical but also need to involve a larger task of preparing the country to implement the necessary changes. To this end, the Slovak Technology University in Bratislava (STUBA) has participated in and carried out successfully the Horizon 2020 project "ingREeS - Setting up Qualification and Continuing Education and Training Scheme for Middle and Senior Level Professionals on Energy Efficiency and Use of Renewable Energy Sources in Buildings". The project, started in 2015, was developed in the framework of the Build Up Skills Initiative and revolved around six main objectives:

- The development of education and training programmes
- The creation of a permanent network of trainers
- The setup of a database of trainers and trainees
- The instalment of measures supporting employers
- The innovation of the system of education
- The piloting of training courses

The project activities targeted various levels and types of professionals, including civil engineers, architects and construction site supervisors. However, more experienced professionals were also contacted to participate in the preparation of materials and the sharing of knowledge. Inclusivity had been a requirement from the start: focusing only on craftsmen and on-site workers would risk hampering the effective deployment of energy efficiency solutions in Slovakia, one of the two countries participating in ingREeS project together with the Czech Republic.

Four pillars were foreseen for the project, including education flexibility (modular training courses), active involvement of enterprises (increasing the practical aspect of the training), cross-sectorial approaches (energy efficiency and use of renewable energy in target areas) and upskilling. Surprisingly, the project was a pioneer without knowing so. While it used in-presence teaching, the ingREeS also set up a well functioning system of ICT-delivered training, using e-learning and online conferencing intensively and already before the Covid-19 pandemic hit the world. This innovative training model could be replicable and further improved, thanks to the experience acquired in the past three years.

The project, according to its participating organisations, had some remarkable outcome and it created a permanent network of trainers who will be able to continue delivering the programmes developed under the project. Most importantly, the observations and feedback from the participants helped shape a set of policy proposals and financial measures. These measures were thought to represent a chance to facilitate adequate demand response for intelligent energy solutions. This, in turn, would motivate middle and senior-level professionals to participate in training programmes, boosting demand for highly qualified professionals and SMEs to invest in continuing education.

As expected in this type of initiative, it was not a path without hurdles. In Slovakia, in particular, the project encountered first resistance from a lack of lifelong learning and training culture among civil engineers. Such a challenge was addressed by reinforcing the innovativeness of the program and facilitating its access to the engineers.

Differently from other projects, the ingREeS project also set up a solid network of trainers and institutions that could continue to organise learning initiatives even after the end of the project. This constitutes its key success: ensuring continuous training is accessible to workers whose skills are a fundamental building block in bringing Slovakia closer to its green objectives through higher energy efficiency and better use of renewable energy sources.

Webpage

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4.12 Shifting the focus from net-zero buildings to green, sustainable neighbourhoods: the Energy Institute Hrvoje Požar's case

Written content

Croatia is one of the EU's youngest members: the country only joined in 2013, and it adopted the European currency just at the beginning of 2023. Nonetheless, it is a highly innovative country: its performance on the European Innovation Scoreboard is above the EU average by 16.5 percentage points, and it continues to increase at a higher pace compared to the continental mean value. However, some weaknesses are highlighted by the EU: Croatia does not have high government support for R&D, and few top R&D spenders in general. This factors, mixed with hardships when starting a business and low entrepreneurial training, risks undermining Croatia's efforts at becoming an R&D powerhouse in Central Europe.

Still, researchers are working hard to turn the tide. This is particularly the case at the Energy Institute Hrvoje Požar (EIHP) in Zagreb. The organisation's unique structure in Croatia makes it more flexible than other research centres. A self-financed institute, the EIHP provides services to both the public and the business sector, facilitating the collaboration process between the two realms, too often detached. The EIHP performs a wide range of tasks, including but not limited to a combination of consultancy services, policy advisory, and basic research. According to Dr Vesna Bukarica, Senior Researcher at the institute's Department for Renewable Energy Sources and Energy Efficiency, "EIHP can be best described as a research consultancy".

The activities of EIHP position it at the forefront of the region when it comes to research and innovation. Not only does it possess the capacity to support Croatian researchers and institutions, but it also operates as a bridge towards the EU for those countries in Eastern Europe that are not yet Member States. In addition, the EIHP keeps ongoing activities with extra-EU countries, getting involved in projects with the United States and United Nations agencies, striving to create a network for research and innovation in Southern Europe. On a more European level, it keeps active collaboration channels with Italy, Slovenia and Hungary as main neighbouring partners.

The institute is active in many fields, including but not limited to energy balance and statistics, energy production and markets, renewable energy, climate and environmental protection, and e-mobility. While being active in all areas with projects, might they be under the scope of Horizon Europe, Interreg or LIFE programmes, one of EIHP's core activities revolves around the sustainability of buildings. Under this topical area, a national training centre for nZEB(N) (net zero

energy buildings) was established. This is the first project started by EIHP, back in 1975 when the institute refurbished its core building. The project went through constant modernisation refurbishments over the years, which made it more sustainable (installation of heat pumps, solar panels and batteries, e-mobility appliances and advanced digitalisation of processes) and an example for the neighbourhood.

The nZEB(N) training centre has exactly a neighbourhood-oriented ultimate goal: to integrate the buildings in the area to create a green, sustainable island in the city. If reached, this goal can pave the way for the creation of replicas throughout the city and even outside of Croatia. This is why Dr Bukarica mentions, “the work we do on the building is done with the neighbours in mind. We want to demonstrate how to make existing buildings smart and able to interact with the power system around them. We strive to create and demonstrate the concept of a zero-emission neighbourhood”. The project does not only revolve around the modernisation of the building, as EIHP keeps an active collaboration with the city administration to scale up the model. This means consulting with the neighbourhood inhabitants and setting up training programmes for professionals and designers.

Still, to show that Croatia is ready to become a leading, innovative powerhouse in the EU-13, the EIHP does not stop at buildings. The institute is involved in many different projects across the country's available funding programmes and the EU schemes. It is also very active in new applications too: they have eight projects active as of 2022, with more applications made over the course of the same year and waiting approaval. Research areas cover various scientific aspects, and with a business outlook, EIHP sets out to become a top R&D spender for the country, reversing the current trend and reshaping Croatia's research scenario.

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4.13 How the clean energy transition can alleviate energy poverty: the COMACT project in Bulgaria

Written content

Energy poverty is still a problem in Bulgaria when it comes to promoting energy-efficient solutions for the building sector, much like many other nations in the Central and Eastern European (CEE) region and the former Soviet Union republics (CIS region). Even though some indicators improved in the 2010s, such as households' ability to keep houses warm enough, many homes still struggle to pay energy bills or to reach certain living conditions[32].

A combination of high energy costs and inadequately energy-efficient buildings, heating systems, and home appliances contributes to the widespread energy poverty in the CEE and CIS region. Most of the reasons for this date back to the changes that occurred after the dissolution of the Soviet Union, when mass privatization in the 1990s drove the majority of low-income residents to

[32] According to the most recent (2020) data from the EU Statistics on Income and Living Conditions (EU-SILC), 22.2% of households are in arrears on their energy bills, and 27.5% of households struggle to keep their houses warm enough.

reside in prefabricated apartment buildings with shared ownership in residential districts outside of the cities and the socialist-era subsidies were removed. Indeed, these peculiar neighbourhood structures in the area, in which multifamily residential buildings are widespread, hindered previous attempts to improve the situation, which requires collaboration amongst the apartment owners.

A new strategy to address the multifaceted causes of energy poverty is required. Such an approach should address the multidimensional causes of energy poverty through, among other tactics, making renovations less expensive and increasing the buildings' energy efficiency.

Although Bulgaria has recently made related efforts, particularly by establishing higher targets for building energy efficiency in its national energy and climate plan (NECP), there are still specific challenges regarding measures application. For instance, even if the existing National Energy Efficiency Plan for Multifamily Residential Buildings (NPEEMZhS) is being fully funded by the government and supported by it in administrative terms, it fails to address this issue effectively, as it does not differentiate between municipalities with different characteristics and types of multifamily residential buildings in Bulgaria[33]. However, it is well known that the factors influencing the effectiveness of the measures and programmes to overcome (energy) poverty are numerous; therefore, policymakers should make an effort to propose comprehensive actions.

Against this background, the Community Tailored Actions for Energy Poverty Mitigation in the CEE and CIS region (ComAct) project seeks to address the urgent need to improve the living conditions of many Bulgarian households in a more holistic manner taking into account three dimensions: stakeholders and communities, financial, technical. ComAct has been testing its innovative approach for alleviating energy poverty in five pilots CEE countries, including Bulgaria.

First, the project conducted a novel analysis of energy poverty in the CEC and CIS region. This was necessary as the multiple dimensions of energy poverty imply that measuring them by different indicators reveals different factors behind it and highlights somewhat different groups suffering from it. Thus, the project started with a fresh new analysis of energy poverty, aiming to show how it becomes apparent in an urban multifamily building context and how it influences potential renovation processes. Building upon a household survey conducted in the autumn of 2021 with 1,025 respondents in the five ComAct pilot sites, their findings are summarised in the "Guidebook on the concept of energy poverty and its relevance in the five pilot countries[34].

As a part of ComAct, a Toolbox of financing models, allowing citizens to browse among the different financing sources for each country and an e-learning platform were set up. Alongside this, several reports which contribute to the knowledge-sharing objective of the project were already published.

Departing from this basis, the ComAct project will renovate four multifamily residential buildings in the cities of Burgas and Gabrovo in Bulgaria. With the collaboration with the City of Burgas and the Center for Energy Efficiency EnEffect, the project will carry on a series of actions, including

[33] https://energy.ec.europa.eu/system/files/2021-08/bg_ltrs_2020_en_version_0.pdf
[34] https://comact-project.eu/wp-content/uploads/2022/04/D1.2-Guidebook-on-the-concept-of-energy-poverty_Final.pdf

the establishment of an Energy Advice Resource Centre to stimulate community action in various homeowner associations (HOA) and design and test financial instruments to lift barriers to access to financing for energy poor households. The final aim is to train local experts and empower local communities to make impactful energy-efficient improvements in multifamily apartment buildings affordable and manageable for energy-poor communities as well as to create the necessary assistance conditions for lifting them out of energy poverty.

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